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PROCEEDINGS

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NOTES ON THE SYSTEMATIC POSITION OF CERTAIN GENERA AND HIGHER GROUPS OF STARFISHES.

BY WALTER K. FISHER.

THE GONIOPECTINIDÆ.—In "Asteroidea of the North Pacific and adjacent Waters"* the family Goniopectinidæ, proposed by Professor A. E. Verrill, was said to differ from the family Porcellanasteridæ in having double ampullæ connected with the tube-feet (p. 19), and in having an intestine and intestinal cœcum. The component genera of the Goniopectinidæ, *Goniopecten* and *Prionaster*, bear the closest resemblance to *Ctenodiscus*, although the rays of the latter are short while in the Goniopectinidæ they are long and slender. This resemblance results from the similar characteristic biserial arrangement of the skin-covered actinal plates with the intervening fasciolar channels, the similar structure of the marginals, between which are cribriform organs, and the similar form and armature of the adambulacral and mouth plates. Recently Mr. A. H. Clark found, in a specimen of *Prionaster elegans* Verrill, single ampullæ, thus breaking down one of the principal differences between *Ctenodiscus* and the Goniopectinidæ. I have again examined the ampullæ in a very large *Prionaster megaloplax* Fisher, and in *Goniopecten asiaticus* Fisher, and have also verified the structure of these organs, as described, in *Goniopecten demonstrans* Perrier. All of these have single ampullæ, what I formerly regarded as the lower lobe of the ampulla, or as a second ampulla, being a swelling probably due to the extreme contraction of the muscular vesicles. If the swelling has any significance at all, it is the merest rudiment of a ventral lobe,

* Bulletin 76, U. S. National Museum, 1911, part 1.

and the ampullæ are to be regarded as single. This fact seems to make it advisable to unite the three genera in a single family which would be separated from the Porcellanasteridæ proper by the presence of cribriform organs between all the marginals, by the actinal fascioles, and by the presence of superambulacral plates. Although an apical pore may be present in *Ctenodiscus*, I have also dissected specimens in which I could find no trace of an opening, nor of a tubular connection between the stomach and the "epiproctal cone." In the middle of the dorsal side of the stomach there is a roundish lobe of small size which may represent the degenerated rudiment of a cœcum. *Prionaster elegans*, on the other hand, has a fairly large, butterfly-shaped cœcum, connected with the apical pore by a definite tubule. *P. megaloplax* has a conspicuous "anal" aperture. This difference between *Prionaster* and *Ctenodiscus* must be weighed against the important common characters mentioned above. I would suggest that the genera be rearranged as follows:

Family Goniopectinidæ.

Characters.—Specialized fascioles or cribriform organs between all the marginal plates; actinal plates in double transverse series, there being between every pair a specialized fasciolar channel, roofed by webbed spinelets, leading from the marginal fascioles to the furrow; ampullæ single; superambulacral plates present; abactinal skeleton astropectinoid.

Subfamily Ctenodiscinæ.

Characters.—Marginal cribriform organs consisting of superimposed transverse webbed combs of spinlets; intestinal cœcum obsolete; no intestine.

Included Genera.—*Ctenodiscus* Müller and Troschel; *?Pectinidiscus* Ludwig.*

Subfamily Goniopectininæ.

Characters.—Marginal cribriform organs consisting of discrete spinelets covered by a single webbed series on the transverse margin of the plate; well developed intestinal cœcum, intestine, and apical pore.

Included Genera.—*Goniopecten* Perrier and *Prionaster* Verrill.

Craspidaster.—*Craspidaster hesperus* (Müller and Troschel), which resembles the Goniopectinidæ in having a single series of webbed peripheral spinelets on the marginal and actinal plates, differs in lacking the characteristic double serial arrange-

* *Pectinidiscus* has not as yet been fully described.

ment of the actinal plates (these being essentially astropectinoid in disposition), and in having patently double ampullæ. It is best considered as representing a separate subfamily of the Astropectinidæ, the Craspidasterinæ (new name).

Mimaster and Radiaster.—In respect to its systematic position *Mimaster* Sladen has been a rather restless genus. Sladen recognized its curious combination of apparently incompatible characters and made it the type of a subfamily of the Pentagonasteridæ. It has been variously regarded as belonging to the Archasteridæ (Perrier, 1894), Plutonasteridæ (Verrill, 1899), and Goniasteridæ (Fisher, 1911), until recently it was dignified by being raised to family rank (Verrill, 1914). Professor Verrill's disposition seems to be the best way out of the difficulty.

Since the publication of the "Asteroidea of the North Pacific" I have had the opportunity of examining two true Mimasters, *M. tizardi* Sladen, and *M. notabilus* Fisher, as well as the *M. cognatus* of Sladen, which appears to be generically distinct.

The abactinal skeleton of *Mimaster* is strongly astropectinoid, the plates being typical penicillate paxillæ, but the marginals, while perhaps neutral, remind one strongly of the marginals of *Cycethra*, a resemblance heightened by the actinal and adambulacral armature, which is decidedly ganeriid. By having definite sucking disks on the tube feet *Mimaster* is removed from proximity to *Leptychaster*, an association suggested by the dorsal surface, including the marginals, while it can not be placed in the Ganeriidæ because it possesses superambulacral plates and lacks the heavily calcified internal interbrachial pillar, the reticulated, imbricated, abactinal skeleton, and the asterinoid abactinal armature of *Cycethra* and *Ganeria*.

In *Mimaster* the *membranous* interradial septum forms a complete partition from the side wall of the disk to a free margin close against the stomach; but in *Cycethra* and in *Ganeria* (as in *Solaster* and in *Asterina*) there is a rigid pillar running from above the mouth plates to the abactinal surface, the cœlom being undivided between this pillar and the margin (an incomplete calcified septum).

In this connection I would like to call attention to the resemblance between *Ganeria* and the Solasteridæ, recently suggested

in conversation, by Mr. A. H. Clark. The marginal plates of *Ganeria falklandica* are essentially like those of Solaster, and in the adambulacral armature we find a very generalized form of the peculiar pectinate type of the Solasteridæ. The form and armature of the mouth plates, the actinal intermediate plates, and even the adambulacral plates can, however, be more nearly matched in the Asterinidæ. The abactinal skeleton, though of on open reticulate form, especially on the disk, is more nearly like that of the Asterinidæ than like that of the Solasteridæ.

While perhaps in some way related to the Ganeriidæ, I think *Mimaster* is well within the Phanerozonia. *Gephyreaster*, which I formerly associated with it in the Mimasterinæ, is probably more nearly related to *Pseudarchaster*. Unless its resemblance to *Mimaster* is only superficial, it may constitute an annectant group.

The purely nomenclatorial side of the matter is complicated by *Radiaster elegans* Perrier. Through the kindness of Dr. H. L. Clark I recently examined the type (unfortunately dried) in the Museum of Comparative Zoölogy (No. 909, Dominica, West Indies, 982 fathoms). From every outward indication this species is a typical *Mimaster*. *Radiaster** has one year priority. The family and its two genera may be summarized as follows:

Radiasteridæ, new name.

Mimasteridae Verrill, Monograph of the Shallow-Water Starfishes of the North Pacific Coast, 1914, p. 282.

Characters.—Phanerozonia with small, subequal, subpaxilliform marginals, resembling the Astropectinidæ abactinally and the Ganeriidæ actinally, but with sucking disks on the tube feet and complete membraneous interbrachial septa, and superambulacral plates; abactinal skeleton consisting of penicillate, usually independent, paxillae; actinal plates imbricated in transverse series, tabulate, with a coördinated tuft of spinelets; adambulacral armature a coördinated tuft of spinelets increasing in length toward the two or three almost undifferentiated furrow spinelets; first adambulacral somewhat compressed; mouth plates rather astropectinoid, with a straight marginal series of spines and without an unpaired median spine at the inner angle; madreporic body covered with paxillae springing from its surface.

Synopsis of the Component Genera.

1. Gonads confined to the disk and consisting of several tufts springing from a common point close to the interbrachial septum; hepatic

* *Radiaster* Perrier, Bulletin Museum Comparative Zoölogy, Vol. 9, June, 1881 p. 17. *Mimaster* Sladen, Proc. Royal Soc. Edinburgh, Vol. 11, 1882, p. 579.

cœca with long subdivisions, so that each ray appears to have from six to ten separate cœca of unequal length; tube feet with well-developed sucking disks; lateral abactinal plates not cruciform nor regularly imbricated

Radiaster [*Radiaster elegans* Perrier, *R. tizardi* (Sladen) and *R. notabilis* (Fisher)].

2. Gonads consisting of numerous tufts extending in a radial series near the superomarginal plates for over half the length of the ray; hepatic cœca two, not appearing multiple on account of long subdivisions as in the preceding; tube feet with very small sucking disks; lateral abactinal plates distinctly four-lobed, regularly imbricated

Mimastrella gen. nov. [Genotype *Mimastrella cognata* = *Mimaster cognatus* Sladen].*

Solaster and Crossaster.—These two genera have been united by most recent writers,† although in practice it is not very difficult to recognize them. Since new species of the *Crossaster* type are continually being described, it is becoming more and more desirable to keep them separate. A good differential character is the presence in *Crossaster* of a complete membraneous interbrachial septum between the internal interradial calcareous dorsoventral pillar and the margin. The pillar arises from the mouth plates and passes upward, its point of union with the abactinal skeleton being usually marked by a smooth spineless area. In *Crossaster papposus* between this calcified buttress and the margin there is a definite septum separating the gonads of adjacent rays, while in *Solaster endeca*, *S. borealis* and *S. abyssorum* the pillar is present, but not the membraneous septum; as a result the gonads of adjacent rays are not separated, and the cœlom is continuous. My recently described *Solaster scotophilus* has a complete membraneous septum and the outward habit of *Crossaster papposus*. It must therefore be classified as a *Crossaster*.

* *Mimaster* can not be used for this group because when described the genus was monotypic. The genotype, *M. tizardi*, being congeneric with *Radiaster elegans*, the name *Mimaster* becomes strictly a synonym of *Radiaster*.

† For some of the reasons for uniting them see "Asteroidea of the North Pacific," p. 329.

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PRODROME OF A REVISION OF THE CHRYSODOMOID WHELKS OF THE BOREAL AND ARCTIC REGIONS.

BY WILLIAM H. DALL.

The following revision of the boreal and arctic Chrysodomoid whelks results from a study of the collection from the north Pacific now contained in the National Museum and brought together from many sources.

The full report on the group will be more or less delayed, but will contain the data upon which this revision is founded, including new anatomical and other details.

FAMILY BUCCINIDÆ.

Genus CHRYSODOMUS Swainson, 1840.
Type *Murex antiquus* Gmelin. Britain.
Section **Sulcosipho** Dall, nov.
Type *Chrysodomus tabulatus* Baird. Puget Sound.
Subgenus **Barbitonia** Dall, nov.
Type *Fusus arthriticus* Bernardi. Japan.
Genus SEARLESIA Harmer, 1914.
Type *Trophon costifer* S. Wood. British Crag. (Recent analogue *Buccinum dirum* Reeve. Puget Sound.)
Genus ECPHORA Conrad, 1843.
Type *Fusus quadricostatus* Say. Miocene, Maryland.
?Genus STENOMPHALUS Sandberger, 1853.
Type *Fusus cancellatus* (Thomae) Sandberger. German Miocene.
Genus COLUS (Bolten, 1798) Dall, restr. 1906.
Type *Murex islandicus* Gmelin. Iceland.
Section **Latisipho** Dall, nov.
Type *Chrysodomus hypolispus* Dall. Bering Sea.

Subgenus Anomalosipho Dautzenberg and Fischer, 1912.
Type *Colus dautzenbergi* Dall, (=*Sipho verkruzeni* D. & F. 1912, not of Kobelt, 1876).

Genus Siphonorbis Mörch, 1869.
Type *Siphonorbis ebur* Mörch. Greenland.

Genus Kryptos Jeffreys, 1896.
Type *Kryptos elegans* Jeffreys. N. E. Atlantic, abyssal.

Genus Plicifusus Dall, 1902.
(*Parasipho* Dautzenberg and Fischer, 1912.) Type *Fusus kroyeri* Möller. Greenland.

Subgenus **Retifusus** Dall, nov.
Type *Tritonium jessoense* Schrenck, 1867. Japan.

Section **Latifusus** Dall, nov.
Type *Chrysodomus griseus* Dall. California, abyssal.

Section **Microfusus** Dall, nov.
Type *Chrysodomus acutispiratus* Sowerby. Japan.

Section **Helicofusus** Dall, nov.
Type *Chrysodomus laticaudatus* Dall. Bering Sea.

Genus Exilia Conrad, 1860.
Type *Exilia pergracilis* Conrad. Eocene. (Recent analogue *Chrysodomus kelseyi* Dall. San Diego, California.)

Genus Volutopsius Mörch, 1857.
Type *Fusus largillierti* Petit. Newfoundland Banks.

Genus Pyrolofusus (Beck) Mörch, 1857.
Type *Fusus deformis* Reeve. Arctic seas.

Genus Beringius Dall, 1879.
Type *Chrysodomus crebricostatus* Dall. Kadiak, Alaska.

Genus Liomesus Stimpson, 1865.
(*Buccinopsis* Jeffreys, 1867, not Conrad, 1857.) Type *Buccinum dalei* J. Sowerby. British Crag.

Genus Ancistrolepis Dall, 1894.
Type *Chrysodomus eucosmius* Dall. Bering Sea.

Section **Japelion** Dall, nov.
Type *Buccinum hirasei* Pilsbry. Japan.

?Genus Sulcosinus Dall, 1894.
Type *Buccinum? taphrium* Dall. Bering Sea.

I refer *Turrisipho* Dautzenberg and Fischer, to *Siphonorbis; Jumala* and *Ukko* Friele, to *Beringius; Neptunea* to *Chrysodomus; Tritonofusus* to the prior *Colus*, with *Sipho* Mörch not Brown, *Neptunella* and *Siphonella*. The entire group of *Fusinus* is separated from *Colus* by its nuclear characters.

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NEW SPECIES OF OPUNTIA.

BY DAVID GRIFFITHS.

This seventh * installment of formal descriptions of new species of *Opuntia* has been somewhat delayed to secure more complete data from the mature cultivated plants. The types will be preserved in the U. S. Department of Agriculture and duplicates will be prepared for other herbaria.

Opuntia magnarenensis sp. nov.

A large hemispherical shrub 100–125 cm. high and 2 m. in diameter when fully developed, with main arms radiating and either ascending or resting on their edges, the secondary ones always erect from them; joints obovate, sometimes widest at middle, but usually widest slightly above middle, pointed both above and below, yellowish-green, slightly glaucous, about 18 by 30 cm.; leaves very large, flattened, prominently acuminate-cuspidate, 10–12 mm. long; areoles very large, oval to obovate, the largest ones on edges of last year's joints commonly 4 by 6 mm. and smallest about 3 by 5 mm., brown turning prominently gray and enlarging with age; spicules yellow, very prominent, scattered, unequal, 1 to 1½ cm. long, increasing tremendously with age in both length and numbers, the areoles becoming very prominent; spines white with light, bright reddish bases, flattened, stout, not annular, spreading in all directions, sometimes twisted, 2–5 mostly 3, the central upper one very long and porrect, 3–5 cm. long, others shorter spreading around it; flowers yellow, 7 cm. in diameter, filaments yellow, style white to greenish tinged, stigma dark green, 7-parted, buds dull greenish-red, pointed, with lax sepals; fruit purplish-red throughout, with abundant bloom, long, obovate, about 4 by 7 cm., its areoles tawney, about 20, bearing spicules 4 mm. long.

This species is common on the Big Sandy, 30–50 miles south of Kingman, Arizona. It is one of the conspicuous species on the bench lands above the river bottoms. In its main characteristics, it resembles more

* Proc. Biol. Soc. Wash. **27**: 23. 1914.

closely *Opuntia engelmannii* than any other species. The type is preserved under my inventory number 10,560, collected near Owens Post Office, Arizona, May 3, 1912.

Opuntia intricata sp. nov.

Plants large, half prostrate, with long tangled arms often nearly a m. in length, mostly lying in a mass, one on top of the other; joints obovate, commonly 11 by 20 cm. glaucous blue-green, variable in size but outline quite uniform, pruinosity lost with age; areoles obovate, 3 mm. long on sides, and 4 mm. on edges of joints, with conspicuous wool, brown and tawney white at margin when young, changing in age to dirty gray; spicules rather bright yellow in a compact triangular tuft in upper portion of areole, about 2 mm. long, increasing in age, and at 2 or 3 years filling entire areole which becomes enlarged and subcircular; spines scattering, only on edges of joints, at apex 1 to 3, mostly 1 to 2, basal portion light yellowish brown, fading to white at about half its length, 2 to 3 cm. long, flattened, twisted, not consistently but frequently annular; flowers light purplish, filaments pinkish above, greenish below, style white with a tinge of reddish above, stigma light green, 8-parted; fruit obovate, pyriform, light purplish-red with abundant bloom, rind and pulp tinting tardily, about 4 by 6½ cm.

This species is rather common in the lower parts of the mountain valleys, and upon the sandy alluvial bottoms at the mouths of washes above San Bernardino, California, and in similar positions southward. Old, mature plants have the habits described above. When grown under cultivation, however, the plants may be erect, or ascending until the arms reach a length of 50 to 75 cm., when they begin to bend over in a tangled mass upon the ground; or as is frequently the case in cultivation, break off at the articulations. This species is found in some of the European collections, and there is not much doubt but that their material was secured originally from A. H. Alvord of San Bernardino, California, who made extensive collections in the region. It has been referred by European collectors as a variety of *Op. basilaris* but it does not belong to that group. This description has been prepared from various notes made in the field, and from cultivated plants grown at Chico, California. The type bears my collection number 10,372 from near San Bernardino, California, May, 1912.

Opuntia aciculata sp. nov.

A low hemispherical shrub, 1 m. high, and 1½ to 2 m. in spread of branch, erect or main arms ascending or even resting on edge, and the secondary erect from them; joints ovate to obovate, mostly pointed above and below, 15 by 20 cm., but the older joints on our plants only 12 by 17 cm., dark green with some bloom; leaves circular in section, subulate, cuspidate, 7 mm. long, gradually recurved as they age; areoles subcircular, varying from 4 to 6 mm. in diameter with the conspicuous brown wool 1 mm. or more above the surface of the joint, about 2½ cm. apart on sides of joints; spicules bright brown, conspicuous and formidable, 5

to 7 mm. long, and tips lighter colored, nearly uniformly scattered throughout the areoles, the tips of the tufts measuring 10 to 12 mm. in spread; spines very few, only an occasional one on an occasional areole, brown, sloping down, 1 to 2 cm. long; flowers yellow with greenish centre 9 cm. in diameter, filaments greenish tinged, style white, stigma dark green, subglobose, 8 to 10-parted; fruit pyriform, deep purplish-red all the way through, having a little bloom up to early maturity.

The type is preserved under my inventory number 10,300, and was collected near Laredo, Texas, June 26, 1911. The description was drawn from cultivated plants grown at Chico, California, May 21, 1914. The distinguishing characters of the species are prominent, brown, abundant spicules, pointed joints, and remarkably few spines. It differs from *Opuntia tardospina* in being smaller in stature throughout, in being almost spineless even in age, and in having differently shaped joints.

Opuntia cretochaeta sp. nov.

Plants tall, arborescent, open-branched, 4 m. high or more in nature, with a distinct cylindrical trunk a meter or more long; joints obovate, 17 by 32 cm., widest at or above the middle, usually broadly rounded above and narrowed below, yellowish-green at maturity, but dark green when young, especially in shaded portions, smooth; areoles obovate, about 4 by 5 mm. and 3 to 3½ cm. apart, at first prominent, turning gray; leaves conical, 4 mm. long, cuspidate; spicules light-yellow, not conspicuous until toward close of growing season but then becoming formidable in a large compact tuft, 5 mm. long in the upper portion of areoles, increasing greatly in length and numbers in age; spines white, at first, single porrect, then 2 and spreading, but at 1 year of age 3 to 5 spreading, the longest 4 or 5 cm. in length, the others shorter, flattened, twisted, and variously bent, increasing greatly in length and numbers in age, often becoming 6 or 7 cm. in length, and 12 to 18 in number, often in transversely elongated areoles a cm. in width at 4 years of age; flowers deep orange-red when opened, dark greenish red with tinge of purple in bud, 5½ cm. in diameter when fully opened; filaments greenish below and white with very faint reddish tinge above, style bright glossy red, with tinge of purple at top, stigma very light greenish with slight purplish tinge on side of dorsal groove, 6-parted; ovary obovate to clavate, 28 by 50 mm., tubercular-raised at areoles, with small brown areoles 1½ mm. in diameter, 8 mm. apart; fruit light purplish-red, the entire surface areolated, bearing commonly 1 white spine in upper areole, obovate, about 3½ by 5 cm.

This species was collected originally near Dublan, Mexico, August 31, 1906, under my inventory number 8465. It has been grown at Chico, California, as well as at Brownsville and San Antonio, Texas.

Opuntia eocarpa sp. nov.

A reclining to ascending, spreading shrub, 75 cm. high and 150 cm. or more in spread, the main branches commonly resting on their edges and

ascending at extremities; joints broadly obovate, often as broad as long, about 20 cm. in diameter, yellowish-green with a little bloom, slightly raised at areoles even at second year; areoles dark, broadly obovate, 5 to 6 mm. in length; spicules yellow, 2 to 3 mm. long on sides of joints and compact along upper edge of areole, but on edges of joints they are divergent, prominent, 8 to 12 mm. long; spines formidable, divergent, stout, flattened, twisted, having light reddish-brown bases and gradually fading distally to white, 3 to 4, large, 3 to 4 cm. long, and 1 or 2 short white ones below, 1 to 1½ cm. long; flower deep yellow, red within, turning deeper yellow and red centre enlarging as day advances, 7½ cm. in diameter when fully opened, resembling that of *O. phaeacantha brunnea*, but larger throughout, filaments light-greenish below, style white, stigma large, very light green, 12-parted, with narrow segments; fruit light red with a tinge of purple and a little bloom toward maturity, but almost none when fully ripe, obovate to elliptical, about 4 x 5 cm. with a sunken, large, roughened scar, rind greenish and pulp colorless, areoles tawney, 2 mm. in diameter, spicules yellow, 2 mm. long, unequal, fugacious spines yellow but lighter and often white distally, 5 to 12 mm. long.

The species belongs to the *phaeacantha* group and differs from any of the described forms in that group in being larger throughout, and in having a different spination. The color of the spines resembles most closely that of *phaeacantha brunnea* of the second year's growth, but is even lighter colored than that. It is found rather commonly in the foothills of the Rellito and Santa Cruz Valleys of Arizona. The type specimen was collected near Pantano, Arizona, in September, 1911, under my collection number 10,452.

Opuntia recurvospina sp. nov.

An erect, open-branched species, 1 m. or more high and 1½ to 2 m. in spread of branch; joints obovate, contracted below into a stipitate base, but often widest at middle, commonly narrowed above into a sharply rounded apex, mostly about 18 by 32 cm., having a little bloom on last year's growth but current season's joints a clear, slightly yellowish-green and decidedly yellowish-green in age; areoles subcircular to broadly oval, brown with compactly formed wool, 1 to 1½ mm. high, 5 to 6 mm. long, enlarging slightly in age; spicules comparitively few, yellow, scattered through upper edges of areoles, unequal, 4 mm. or less in length in an occasional areole only, increasing but slightly with age; spines white with light brown to flesh-colored bases, flattened, twisted, 2 to 5 in number, mostly 2 or 3, spreading in all directions the second year and after that tightly recurved in all directions; flowers light yellow, 8 cm. in diameter, slightly greenish tinged within, filaments light above, greenish below, style white, stigma light-green, globose, 10-parted; fruit obovate, pyriform, about 4 by 7 cm., deeply pitted, purplish-red throughout, having a little bloom up to maturity but after that deep dark-red, its areoles tawney, with prominent wool, spicules yellow, 4 mm. long, unequal, located in central upper portion of areole, fugacious spines, remarkably prominent,

varying from close to length of spicules to 20 mm., and often 12 in number.

This species inhabits the foothills regions of the Rellito and Santa Cruz Valleys of southern Arizona. It is characterized by its large joints, peculiarly shaped for this group, recurved spines, and large, pyriform fruit. The type was collected near Pantano, Arizona, in September, 1911, under my inventory number 10,456.

Opuntia superbospina sp. nov.

Plants low, spreading, 30 to 40 cm. high and having a spread of 125 cm. or more, main arms resting on edge with distal segments ascending and secondary branches erect or ascending from the primary; joints obovate, about 10 by 19 cm., rather sharply rounded above and contracted below, with a moderately long stipitate base, very glaucous gray-green, slightly raised at areoles for about 2 years, turning yellowish-green in age; areoles large, obovate to oval, with prominent brown wool, about 6 mm. long; leaves short, subulate, cuspidate-pointed, pinkish, slightly recurved, 4 to 5 mm. long; spicules very prominent in a large tuft in upper portion of areole, yellow, 1 cm. long, continuing to increase for 2 years at least, in successive zones, from central areolar area; spines long, formidable, at first brownish at bases, especially at apex of joints, and white on sides, but all becoming white or nearly so in age, all but the lowermost areoles armed, 1 below to 3 or 4 above, stout, porrect-spreading, with the lowermost in the areole recurved and shorter than the others which are 6 cm. long on current year's growth, ranging to 8 cm. the second year and even longer than this in age; flowers yellow, red within, 7 to 8 cm. in diameter when fully opened, fading to pinkish and becoming more red in centre toward close of day, filaments pink, style white or slightly tinted, stigma white, 6-parted; fruit dull grayish-red with abundant bloom, rind greenish and pulp colorless, areoles about 18, gray to dull tawney, small, subcircular, 2 mm. in diameter, spicules yellow, 2 to 3 mm. long, fugacious spines, 2 to 5 or 6, and merging from length of spicules to 6 mm. in length, all yellow and much duller in color than the spicules of the stem.

The species is characterized by its very glaucous aspect, prominent yellow spicules and long, nearly white spines which are so numerous and formidable that it is impossible to get down into the centre of the plant. It was secured under my collection number 10,574, about 15 miles southeast of Kingman, Arizona, and has been observed in several localities in the same general region.

Optunia caesia sp. nov.

Plant a spreading shrub with main arms resting on their edges and the secondary ones erect from them, 60 cm. high and 2 m. in spread when fully matured; joints deep, glaucous blue-green, becoming yellowish-green in age, obovate, about 11 to 15 by 20 to 24 cm., gradually narrowed below to a stipitate base; areoles 4 mm. long, brown; spicules dark-brown in a compact tuft in the upper portion of areoles, 4 to 5 mm. long,

except at very apex of joints where in extreme cases they may be 15 mm. in length ; spines the first year 2 to 4, dark-brown except the lower downward sloping shorter ones, 15 to 20 mm. long, which are white, the others porrect and the longest often 6 to 8 cm. in length ; the second year fading to light-brown or yellow flesh-color, becoming white with age and increasing slightly in numbers, some of those on old wood very much flattened and twisted, annular at the base, especially the second season; flowers yellow with red centres, filaments yellow but greenish at base, style white, stigma large, subglobose, light-green ; fruit purplish-red with a deep bloom and much lighter colored within, the rind simply streaked with red and pulp slightly mottled, only at complete maturity is the color of the rind and pulp diffused and light-red, areoles small, elongated, ½ to 2 mm. long when wool is removed but before removing wool 3 mm. long and broadly oval, dull, dark gray, tawney with wool protruding 1 mm. and the brown, unequal spicules 2 mm. longer than the wool, fugacious spines irregular, 6 to 11 mm. long, lighter colored, often brownish to yellowish-white at maturity.

The species is easily recognized by the densely glaucous aspect of plant and fruit and shape of its joints. It has nearly as much bloom as the *O. robusta* group of the Mexican highlands. The type was collected between Crozier and Hackberry, Arizona, the first of May, 1912, under my inventory number 10555. It has been observed in several situations in that general region and one other collection has been made and cultivated.

Opuntia expansa sp. nov.

A low, spreading species with long, radiating arms, 50 cm. high and having a spread with us now of 160 cm. but in natural habitat the radiating arms often 130 cm. in length and the entire plant 2½ to 3 meters or more in diameter and reaching an extreme height of one meter, main arms radiating and resting on edge ; joints obovate, at first glaucous but losing its plumosity and becoming yellowish-green with age, about 11 to 13 by 20 to 22 cm., rounded above and contracted below into a more or less stipitate base; areoles broadly obovate to subcircular often 6 mm. in length on edges but commonly only 4 mm. on sides of joints, brown turning dirty black, becoming very prominent, subcircular and often 3 mm. high on old joints; spicules yellow to light-brown, in a compact tuft above, scarcely as long as the protruding wool with a few scattering bristles, more numerous and longer in age especially on edges toward apex of joints, sometimes 8 mm. long and always yellow in situ; spines light-brown at base, white distally, toward apex of two-year old joints there are commonly 4 to 5, the lower being white, 1 to 1½ cm. long, the next situated directly above usually 3 cm. long, white throughout or dirty yellow to brownish at base, the other 2 or 3 slightly shorter and more deeply colored, commonly brownish below and yellowish distally but color variable; flowers 8½ cm. in diameter, yellow with dull red centre, the red coloration streaking upward through the veins late in the day, buds with decidedly glaucous-greenish sheen and scales lax; fruit

deep purplish-red all the way through with a little bloom in early maturity, but almost maroon when fully matured, obovate, deeply pitted, about 3 by 5½ cm., areoles 2½ mm. in diameter, tawney, bearing yellowish spicules 2 mm. long and about 4 fugacious spines 5 to 6 mm. long in upper areoles.

This species is rather common among the piñons and junipers of the Anton Chico region of New Mexico and is commonly found associated with *Op. engelmannii cyclodes*. The type was collected under my inventory number 10,324 near Anton Chico, New Mexico, in August, 1911. It has also been received and secured under other numbers from Casaus and the mouth of the Gallinas.

Opuntia xerocarpa sp. nov.

A low spreading species 25 to 35 cm. high and a meter in spread, the main arms usually resting on their edges and the secondary growth erect from them; joints mostly obovate, thick and turgid, 7 to 9 by 11 to 14 cm., glossy yellowish-green, broadly to sharply rounded above; areoles broadly obovate to subcircular, 3 mm. long, at first brown with a marginal white zone soon turning completely tawney-brown and then dirty gray; spicules light-brown but inconspicuous on current year's growth, but on last season's wood 1 to 2 mm. long and continuing to develop in successive interior zones and frequently becoming 5 mm. in length in very much enlarged areoles; spines white, commonly 1 central 3 or 4 cm. long, flattened, twisted and sloping down, and 2 or 3 recurved downward sloping radials below, 1 cm. long or less, on edges of joints, however the centrals may be 2 or even 3 and the radials lengthened to 2 cm. and increased to 4 or 5; flowers yellow, 5 to 6 cm. in diameter, slightly greenish within, filaments yellow above and greenish at base, style white, stigma dark green, about 7-parted; fruit dry, 3½ to 4 cm. long and 1½ cm. in diameter, obovate to cylindrical, when fully matured green with a blush of red on one side, bearing about 24 small subcircular areoles, 6 to 8 mm. apart and bearing a small tuft of brown spicules and 1 to 3 or 4 short white spines, commonly 5 to 7 mm. long, and 2 or 3 to several fugacious spines of similar length.

This is a very characteristic, dry-fruited, flat-jointed *Opuntia* of the western slope of the San Francisco highlands. It is readily distinguished from other species of its dry-fruited allies by its spines, shape of joints and color of plant body. The type was collected about 15 miles southeast of Kingman, Arizona, in May, 1912, under my inventory number 10,579 and has been in cultivation since that time, other collections having been grown previously.

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PROCEEDINGS

OF THE

BIOLOGICAL SOCIETY OF WASHINGTON

DESCRIPTION OF A NEW HAZEL GROUSE FROM MANCHURIA.

BY J. H. RILEY.

[Published by permission of the Secretary of the Smithsonian Institution.]

In these Proceedings,* under the description of *Tetrastes bonasia vicinitas*, I mentioned two specimens from Manchuria and provisionally referred them to *Tetrastes bonasia septentrionalis*. Mr. Copley Amory, Jr., has recently presented to the U. S. National Museum a fine series of seven specimens of true *Tetrastes bonasia septentrionalis* from near Verkhni Kolymsk, on the upper Kolyma River, N. E. Siberia. A comparison of these with one or two additional specimens not available when I wrote my other paper has shown the Manchurian birds to represent a very distinct form. It may be known as:

Tetrastes bonasia amurensis subsp. nov.

Type, U. S. National Museum, No. 236,907, adult male, near I-mien-po, N. Kirin, Manchuria, October 14, 1914. Collected by Arthur de C. Sowerby (orig. No. 243).

Differs from *Tetrastes bonasia bonasia* in having less white over the incipient ruff; in being grayer above (than in the gray phase) with a mere trace of deep hazel in the interscapular region; and in having the underparts more heavily marked and with a deeper shade of brown or black.

Description.—Nasal plumes blackish mixed with white and along the culmen with chestnut-brown; frons, a rictal stripe, lower eye-lid, and a spot behind the eye, white; the white of the frons separated in the middle by deep chestnut-brown and blackish and bordered posteriorly by blackish; top of head a rather deep drab, washed with russet, especially on the nape, and with indistinct irregular blackish bars; interscapular region hair brown with blackish and deep hazel bars; lower back and rump mouse gray with more or less distinct shaft streaks and fleckings of blackish and with a rather broad sub-apical band of snuff brown, mostly concealed but showing through enough to give a slight

* XXVIII, 1915, 161.

cast to this region; upper tail-coverts mouse gray with irregular bars and fleckings of blackish and with a slight wash of snuff brown; a line below eye and the ear-coverts mars brown, the former with some blackish spotting; sides of neck russet with irregular black bars and an apical grayish-white spot; the longer feathers over the incipient ruff blackish with some chestnut-brown on the inner web and with most of the outer web white; chin and throat black, bordered by white; feathers of the lower parts gray at the base, then auburn, then black, with a broad sub-terminal bar of white and with a more or less narrow edging of black, the latter lacking on the lower breast and belly; the chest just below the white edging to the throat strongly washed with a narrow band of hazel; flank feathers hazel with a sub-terminal black bar and a rather broad white tip; under tail-coverts vandyke brown vermiculated with black and with a narrow irregular subterminal black bar, broadly tipped with white; lesser wing-coverts hair brown barred with black and with a subterminal bar of pinkish-buff; alula and primary coverts hair brown irregularly margined on the outer web with pinkish-buff; middle and greater wing-coverts hair brown with black stippling and with more or less extensive guttate spots of light buff; primaries and secondaries chaetura drab, irregularly edged on the outer web with pinkish buff; tertials tawny towards the end, stippled with black and edged with ochraceous-buff, the outer web with a rather large spot and bar of black; scapulars russet with black stipplings and some rather large black spots and bars, the anterior feathers with buffy shaft streaks, the posterior with rather large white or buffy-white terminal spots; middle tail-feathers Prout's brown with irregular bars of wood brown and black, the whole stippled with black; outer tail-feathers neutral gray stippled with black and with a broad sub-terminal band of black; tarsi light grayish olive with a buffy wash and some obscure dusky markings. Wing, 162; tail, 110.5; culmen, 18.

Remarks.—I have given a rather detailed description of this form as it is so very different from anything before me. From *Tetrastes bonasia septentrionalis* it is so very distinct that it hardly needs comparison; that form is clear neutral gray above, lighter on the rump, with the black barring rather narrow on the interscapular region and with only the scapulars showing brown (hazel), while in the present form the back is hair brown with deep hazel bars and the black bars a little broader but not so numerous. The wings of *T. b. septentrionalis* are also very different from *T. b. amurensis*, the former contain more white and the edgings to the feathers are broader.

Of *Tetrastes bonasia amurensis* I have three males before me, two from the type locality and one from the Amur (near Nikolaievsk); they are similar except the hazel wash across the chest is much more pronounced in the type, in fact in the other two specimens it is almost entirely lacking.

	Wing.	Tail.	Culmen.
Three males from Manchuria average:	164.5	110.7	16.7
Six males of *T. b. septentrionalis*:	159	115.2	15.8

For measurements of European and Japanese specimens, see these Proceedings, XXVIII, 1915, p. 162.

Vol. XXIX, pp. 19-20 January 25, 1916

PROCEEDINGS

OF THE

BIOLOGICAL SOCIETY OF WASHINGTON

A NEW ANOLIS FROM CUBA.

BY T. BARBOUR AND C. T. RAMSDEN.

Not long ago Doctor Stejneger kindly loaned us for study a number of specimens of *Anolis* collected by Messrs. Palmer and Riley in Cuba during the year 1900. He is preparing a report upon this collection for publication and noted that it contained this new species. Nevertheless since we also had the species in manuscript he has generously allowed us to describe it. For this courtesy we owe him our sincere thanks. This pretty little lizard may be called

Anolis mestrei sp. nov.

Type, M. C. Z. No. 11,285 from the Valley of Luis Lazo, Western Pinar del Rio, Cuba, collected in March, 1915, by T. Barbour. Paratypes M. C. Z. No. 11,286, from the same locality, also U. S. Nat. Mus. Nos. 26,731, 32, 33 from San Diego de los Baños and No. 27,344 from "El Guamá," a finca near the city of Pinar del Rio, all four specimens from the Palmer and Riley collection.

Description of the type.—Head with two slightly diverging ridges on the frontal region; forehead concave; all the head scales rather feebly keeled; seen from in front rostral about the same height as the mentals; six elongate scales between the nostrils; a single series of scales separating the supraocular semicircles; occipital slightly smaller than ear opening, separated from the supraocular semicircles by about four rows of scales, which are very much larger than the dorsal granules and slightly larger than the scales which bound the occipital posteriorly; supraorbital disc composed of about six large and a few additional smaller but somewhat enlarged scales; these are all very feebly keeled and arranged in gradation, the largest scales nearest the scales of the semicircles, which they match in size; there are about 3 series of enlarged scutes in the discs; disc separated from semicircles by one row of granules; three or four scales between the superciliaries and the supraorbital semicircles bounding the area of the supraorbital granules anteriorly; canthus rostralis sharp, consisting of five or six elongate shields which are

continuous with the superciliaries; loreal rows five or six; subocular semicircles in contact with supralabials; supralabials six, the suture between the fifth and sixth under the centre of the eye; temporals excessively minute, granular, no enlarged series forming a supratemporal line; dorsal and lateral scales minute, granular, none on the middorsal line enlarged; ventral scales medium in size, flat, imbricate, without trace of keel; scales of throat and chest also smooth; forelimbs above with small, imbricate, very feebly keeled scales, smaller than the ventrals; femur and tibia with similar but slightly larger and smooth or very feebly keeled scales; fingers and toes above not distinctly carinate; digital expansion narrow, about 15 lamellae under phalanges II and III of fourth toe; tail broken in type; (in U. S. N. M. No. 26,731—tail long, compressed, without a "fin," divided into irregular segments of about 5, keeled scales each, the limiting row of each segment slightly enlarged); in type, dewlap rather large, with smooth scales, anterior edge slightly thickened; postanal scales not enlarged.

Color of the type in life, mottled gray brown, of more or less a "salt and pepper" appearance. Dewlap white, with a large rich red brown spot at its base, surrounded by the white; the scales of the brown area white like the rest, the skin only colored. Belly whitish but throat with longitudinal dark lines. (All the paratypes show this character.)

Variation.—There is marked variation in the degree of carination of the head shields. U. S. N. M. No. 26,931 has them almost smooth, yet we can not believe that this specimen represents a separate species.

Habits.—The species seems to be one which is found almost wholly along the edges of woods on the trunks of trees and in shrubbery. The first author observed it often in the Valley of Luis Lazo and on his return was surprised to find but two specimens among the Anoles secured. While there with Prof. de la Torre and his assistant Señor V. J. Rodriguez, Barbour's companion, Mr. W. S. Brooks, was taken with a very severe fever and in the hurried packing up of our booty and rather precipitate departure we fear that some specimens may have been left behind. Suffice it then to say that we recognized the species at once in life as one completely unknown to us and one which we have not seen elsewhere during our many journeys throughout Cuba. Mr. and Mrs. Barbour collected during part of 1912 at San Diego de los Baños but failed to find the creature there as Palmer and Riley did—probably because they were at San Diego during a singularly cool and dry season when all Anoles were rare.

We have named this species for an old friend, Doctor Aristides Mestre, Adjunct Professor of Biology at the University of Havana.

Vol. XXIX, pp. 21–24 February 24, 1916

PROCEEDINGS

OF THE

BIOLOGICAL SOCIETY OF WASHINGTON

APLODONTIA HUMBOLDTIANA, A NEW MOUNTAIN BEAVER FROM THE HUMBOLDT BAY DISTRICT, CALIFORNIA.

BY WALTER P. TAYLOR.

[Contribution from the Museum of Vertebrate Zoölogy of the University of California.]

The range of the genus *Aplodontia* within California embraces three areas: The Cascade-Sierra Nevada mountain system from the northern boundary of the State south at least to Mammoth, Mono County; the Trinity-Siskiyou mountain mass in the extreme northern part of the State; and the coast district from the northern boundary of the State south to San Francisco Bay. Two coast forms have already been described: *Aplodontia phæa* Merriam, from Point Reyes, Marin County, and *Aplodontia nigra* Taylor, from Point Arena, Mendocino County. It has been known for some time that another form of *Aplodontia* occurs in the Humboldt Bay district, but lack of adequate material for description and comparison has postponed the decision of its systematic status till now. The writer desires to express his thanks to the authorities of the Field Museum of Natural History, and particularly to Mr. Wilfred H. Osgood, Assistant Curator of Mammalogy and Ornithology, for the loan of specimens for study.

Aplodontia humboldtiana new species.

Type.—Male adult, No. 21,162, Mus. Vert. Zool.; Carlotta, Humboldt County, California; January 4, 1914; collected by H. E. Wilder; Orig. No. 1494; stuffed skin, with skull and jaws, all in good condition.

Diagnosis.—Similar in coloration to *Aplodontia chryseola*, but darker; paler hue of brown series of colors interspersed with black hairs; ventral brown wash much less distinct. Skulls may usually be separated from

those of *chryseola* by outline of nasals. In *humboldtiana* the embayment in the lateral outline tends to be more pronounced and situated farther forward than in *chryseola*. Interpterygoid fossa usually broader; paroccipitals lighter; measurement transversely across angular process of mandible less.

Comparisons.—Examples of *Aplodontia humboldtiana* are larger and less richly colored than topotypes of *A. pacifica* from Newport, Oregon. From the new form one receives the impression of black interspersed with buffy, while from *pacifica* one gets the impression of rich brown, with black hairs plentifully insprinkled, and especially emphasized on the middle line of the back. *A. humboldtiana* is not so black as *A. nigra*, which is the darkest member of the genus known to date. The new form is less rich in brown coloration than any of the species occurring in contiguous districts, with the possible exception of *nigra*, *chryseola* being next in degree of richness, and *pacifica* the brightest of all. *A. humboldtiana* is also marked off from all its neighbors by the faint brown wash ventrally. In *nigra* the ventral brown wash is more distinct, in *chryseola* still more distinct, and in *pacifica* the most distinct of all.

Cranially *Aplodontia humboldtiana* can usually be separated from *A. pacifica* by the broader outline of its nasals, which are in most examples conspicuously dilated anteriorly rather than straight as in the Oregon species. Zygomatic width tends to be greater in *humboldtiana* than in *pacifica* or *A. nigra*, more as in *A. chryseola*. In general the cranial measurements of the new form tend to be greater than in *pacifica* or *nigra*. Nine of the fifteen specimens of *humboldtiana* measured have the width of the interpterygoid fossa equal to or exceeding the maximum of this measurement in *chryseola* and *pacifica*. *A. humboldtiana* has paroccipital processes intermediate in condition between the less prominent, more plate-like type observed in most examples of *pacifica* and the more prominent, heavier, more knob-like type noted in *chryseola*. Measurement transversely across angular process of mandible practically the same in *humboldtiana* as in *pacifica*, less than in *chryseola*. But greatest length of mandible links *humboldtiana* with *chryseola* rather than with *pacifica*. This measurement affords a separative character as between *humboldtiana* and *nigra*, also, being greater in the former than in the latter.

Material.—Twenty-one specimens, all from California: 8 (Nos. 21,155–21,162, Mus. Vert. Zool., taken by H. E. Wilder) from Carlotta, Humboldt County; 7 (No. 11,413, Mus. Vert. Zool., taken by Frank Stephens; Nos. 18,990–18,994, 19,174, Mus. Vert. Zool., taken by H. E. Wilder) from Cuddeback, Humboldt County; 5 (Nos. 9061–9064, 9066, Field Mus. Nat. Hist., taken by E. Heller) from Eureka, Humboldt County; 1 (No. 21,983, Mus. Vert. Zool., taken by H. S. Prescott) from Requa, Del Norte County.

Measurements.—Type (adult male): Total length, 365 mm.; tail vertebræ, 35; hind foot, 58; basilar length of skull, 59.8; width of nasals, 10.5; length of audital tube, 19.4; length of incisive foramina, 7.5; zygomatic width, 53.9; greatest width of interpterygoid fossa, 5.5; mastoid

width of cranium, 53.7; alveolar length of superior cheek teeth, 18.7; distance between infraorbital foramina, 16.1; mandible, transversely across angular process, 22.1; greatest length of mandible, 48.4.

Remarks.—Germane to this discussion are the following facts: For some time it has been recognized that the *Aplodontia* of the Humboldt Bay district is distinct from its coast-dwelling neighbors. Concerning the degree of its relationship to *Aplodontia chryseola* of the neighboring montane district interiorly there have been no adequate data at hand. A fairly sharp faunal line separates the Trinity Mountain district from that of the northern humid coast. At least seven genera of rodents are represented in the two regions by distinct species or subspecies. Consequently it is not surprising to find that adequate material shows that the *Aplodontia* of the coast region is distinct from that in the neighboring montane district.

It is, however, somewhat surprising to find that the closest affinities of *Aplodontia humboldtiana* are with *A. chryseola* rather than with its neighbors on the coast, for the affinities in most groups of mammals would appear to be north and south in the coast districts rather than east and west from the coast districts to neighboring montane districts. At least this seems to be true in the genus *Aplodontia*, which has the rather compact group of coast-dwelling forms represented by *Aplodontia phæa*, *A. nigra*, and *A. pacifica*, apparently more closely related to each other than to any other members of the genus. Grinnell has shown (An Analysis of the Vertebrate Fauna of the Trinity Region of Northern California, Univ. Calif. Publ. Zool., vol. 12, 1916, pp. 401, 407) that there are few Boreal species, either of birds or mammals, in the Trinity region which are identical with, or show closest affinities to, representatives in the northern humid coast belt. It is of interest that no rodent appears among the species listed by him as illustrative of close affinities in this direction.

Consequent upon these considerations it appears that *Aplodontia humboldtiana* furnishes an exception to the usual systematic alignment in the region in question, having its closest affinities rather with its montane neighbor to the eastward, than with its lowland neighbors either north or south along the coast.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DESCRIPTION OF A NEW CISCO FROM LAKE ERIE.

BY TARLETON H. BEAN.

On September 21, 1915, Mr. Phillip H. Hartman, Superintendent of the State Hatchery at Erie, Pa., showed the writer a cisco which he had obtained from a Lake Erie fisherman, and which he has recently sent to me for description. The fish is so remarkable in the development of its fins as to raise a question concerning its relation to the normal forms of Lake Herring of the Great Lakes. The pectorals extend beyond the origin of the ventrals. The ventrals reach beyond the end of the anal base. The longest anal ray exceeds the depth of the body. The longest dorsal ray is more than one-third of the length of the fish without caudal.

Leucichthys macropterus new species.

The type of the species, an immature male, is 244 millimeters long without the caudal. D. 11; A. 11; scales 8-74-8; scales between occiput and dorsal fin 34; branchiostegals 8; gillrakers 8+22, the longest equal to eye; head 4.28 in length; depth 4; length of caudal peduncle 10.5; depth of caudal peduncle 12; eye 4⅔ in head; long diameter of orbit equals distance from tip of snout to eye, 4 in head, and about equal to interorbital space; length of maxilla from tip of snout 3 in head; mandible very slightly projecting, 2⅓ in head; distance from snout to occiput twice length of maxilla.

Distance from ventral origin to pectoral origin five-sixths of pectoral length; length of pectoral one and two-thirds times head. Length of ventral nearly twice length of head. Accessory ventral about equal to maxilla. The longest dorsal ray one and one-half times head.

The length of the base of adipose dorsal is only slightly greater than the height of the fin, and is not equal to the eye. The longest anal ray somewhat exceeds depth of body. The lower caudal rays longest, equalling length of pectoral.

Colors in formalin, upper parts pale brownish, paler below; fins all pale; eye dark bluish with traces of bronze on the iris.

The measurements are given in millimeters in the following table:

MEASUREMENTS OF LEUCICHTHYS MACROPTERUS.

	mm.
Length without caudal	244
Comparative measurements:	
Head, 4.28 in length	57
Depth, 4 in length	65
Caudal peduncle	
Length	23
Depth	20
Eye, 4⅔ in head	11
Orbit, long diameter	15
Snout from eye	15
Interorbital space	16
Maxillary length from tip of snout, 3 in head	19
Mandible, very slightly projecting	25
Snout to occiput	38
Ventrals to pectorals (ventral origin to pectoral origin)	81
Pectoral length in ventral-pectoral distance	.85
Pectoral length	95
Ventral origin from tip of snout	137
Ventral length	107
Accessory ventral length	18
Dorsal height (longest ray)	85
Dorsal origin from tip of snout	123
Adipose length—length of base	9
Adipose height	8
Anal height (longest ray)	70
Lower caudal rays (longest)	95

The discovery of this singular form of cisco is due to the watchfulness of Superintendent Hartman over the collections of fishes obtained by fishermen and collectors in the vicinity of the Erie Station. The specimen was caught in a gill net by the tug *Erie*, December 19 or 20, 1914, on a north course out of Erie near the boundary line between New York and Canada.

Type in U. S. National Museum, Washington, D. C., catalogue number 76,845.

Vol. XXIX, pp. 27–36 February 24, 1916

PROCEEDINGS

OF THE

BIOLOGICAL SOCIETY OF WASHINGTON

NEW EAST INDIAN STARFISHES.

BY WALTER K. FISHER.

The new species of starfishes* herein described were collected by the U. S. Fisheries steamer *Albatross* during her cruise of 1907–1910. The type of *Asterina cristata* is from the Museum of Comparative Zoölogy, of Cambridge, Mass. The other types are in the U. S. National Museum. These species will be fully described and figured in the final report.

Asterina cristata new species.

Diagnosis.—Related to *A. cepheus*, but with a variable number of abactinal plates (upward of 50 to a ray) elevated and tubercular in form and surmounted by 1 to 5 unequal, robust, pointed spines, the largest 4 or 5 times as long as the spinelets of the other plates, and many times greater in diameter; other abactinal plates with 5 to 10 short, sharp spinelets in spaced groups, mostly on the adcentral border; in center of disk a poorly defined pentagon of elevated plates; at base of ray, 6 regular longitudinal series of papulæ on either side of a radial area of irregularly arranged pores. Inferomarginal plates with a conspicuous tapered spine surrounded by smaller spinelets. Actinal intermediate plates with a group of 2 to 4, mostly 3, basally webbed spinelets; furrow spinelets usually 6, webbed for about half their length, the 3 or 4 median conspicuously larger than the laterals; subambulacral spinelets usually 4, the 2 median much longer than the laterals (in another specimen there are 5 or 6, of which 2 are enlarged). Rays 5, rather narrow, with a rounded extremity. R=37 mm., r=14.5 mm., R=2.5 r; breadth of ray at base, 15 mm.

Type.—No. 689, Museum of Comparative Zoölogy.

Type-locality.—Ponapé, Caroline Islands.

*New genera and species from the *Albatross* Philippine collection have already been published in the Proceedings of the United States National Museum as follows: vol. 40, May 17, 1911, pp. 415–427; vol. 43, Feb. 5, 1913, pp. 599–648; vol. 46, Sept. 30, 1913, pp. 201–224.

The characteristic feature of this species is the presence of elevated abactinal plates with robust conical spines, forming conspicuous protuberances, very variable in number.

Pteraster corynetes new species.

Diagnosis.—Abactinal surface resembling superficially that of *P. pulvillus;* probably more nearly related to *P. semireticulatus.* Paxillæ with low pedicel surmounted by 7 or 8 longer, radiating, peripheral spinelets surrounding a central shorter one; tips of peripheral spinelets united by fibrous tissue; spiracula in lines between spinelets; no deposits in supradorsal membrane; furrow fans with 7 spines (distally, 6); actinolateral spines stout, the tips defining ambitus; 5 oral spines, the 10 united by a continuous membrane; suboral spine may be entirely lacking; when present, slender, tapering. Rays 5; R=24 mm., r=13 mm., R=1.8 r; breadth of ray at base, 14 or 15 mm.; thickness of disk, 9 mm.

Type.—Cat. No. 37,014 U. S. N. M.

Type-locality.—Station 5623, Molucca Passage, 7.5 miles northeast Makyan Island (0° 16′ 30″ N., 127° 30′ E.), 272 fathoms, fine sand, mud; 1 specimen.

In my key to the species of *Pteraster* (Asteroidea of the North Pacific, p. 368), *P. corynetes* belongs to the second section, although the rays are slightly longer than in the other species. Among those species having all the oral spines united by a continuous membrane, only 5 are comparable with *corynetes*, namely *pulvillus*, *temnochiton*, *rugatus*, *semireticulatus*, and *ingolfi*, to none of which it is closely related.

Pteraster obesus myonotus new subspecies.

Diagnosis.—Closely related to *P. obesus* H. L. Clark, of Japan, and resembling superficially *P. pulvillus* Sars. Differing from *obesus* in being nearly pentagonal in form, in having a fairly tough supradorsal membrane in which there are well developed bands of muscle forming a reticulum of hexagons and triangles; and in having fewer paxillar spines (7); adambulacral spines 5 (6 on the first few plates), the innermost very short; 7 or 8 free oral spines, the innermost flattened and truncate; suboral spine sharp, a little longer than longest oral spine, and with the distal half hyaline, tapering, three-edged. R=28 mm.; r=24 mm.; R =1.2 r.

Type.—Cat. No. 37,015 U. S. N. M.

Type-locality.—Station 5518, Mindanao Sea, off Point Tagalo, 200 fathoms, gray mud, globigerina; bottom temperature 54° Fahr.

Diplopteraster multipes patagiatus new subspecies.

Diagnosis.—Closely resembling *D. multipes*, but differing in having narrower paxillar areas (exclusive of actinostomial membrane) and in having the same number of spines in both sorts of furrow combs (or if an

unequal number, then one more in the non-prominent combs, instead of one less, as in *multipes*); adambulacral spines longer. R=95 mm.; r=60 mm. (measured to edge of actinostomial membrane); R=1.5 r; r=50 mm., measured to edge of paxillar area; breadth of paxillar area at interradias, 50 to 57 mm. (=60% or less of R, while in *multipes* it equals 80%, or more, of R.

Type.—Cat. No. 37,016 U. S. N. M.

Type-locality.—Station 5656, Gulf of Boni, Celebes (3° 17′ 40″ S., 120° 36′ 45″ E.), 484 fathoms, gray mud; bottom temperature, 41.2° Fahr.

Hymenaster rhodopeplus new species.

Diagnosis.—Closely resembling *H. nobilis* Sladen, but differing in having 7 instead of 6 rows of paxillae to each ray, in having a stouter and longer adambulacral spine (much longer than aperture papilla), and in having 2 acicular suboral spines to each plate (instead of 1, resembling an aperture papilla). Marginal contour pentagonal; R=82 mm.; r=55 mm.; breadth of paxillar area at base, 35 mm.; distance from center of disk to margin of paxillar area on interradial line, 30 to 32 mm.

Type.—Cat. No. 37,017 U. S. N. M.

Type-locality.—Station 5606, Gulf of Tomini, Celebes (0° 16′ 28″ N., 121° 33′ 30″ E.), 834 fathoms, green mud.

Hymenaster bartschi new species.

Diagnosis.—Very similar to *H. pullatus*, but differing in having the paxillar areas of the 5 rays separated interradially nearly to the oscular valves, and in having numerous spiracula in the supradorsal membrane, there being a series of band-like spiracular areas along either side of the paxillar areas extending toward the interradial line. General contour originally probably nearly pentagonal, produced at the corners into attenuate tips. R=about 70 mm. Supradorsal membrane very thin and transparent between the numerous, conspicuous, criss-crossing muscle bands. Pseudopaxillae in 7 rows, the median and adradial rudimentary, with 1 to 3 tiny spinelets; the 2 lateral series with 3 or 4 spinelets to each paxilla. Furrow spinelets 3, flattened at the base and tapering to a point, the adoral slightly the longest (1.5 to 1.75 mm.). Actinolateral membrane broad, rather thin, deep brown in color; twelfth to seventeenth actinolateral spines the longest.

Type.—Cat. No. 37,018 U. S. N. M.

Type-locality.—Station 5428, Sulu Sea, off eastern Palawan (9° 13′ N., 118° 51′ 15″ E.), 1105 fathoms, green mud; bottom temperature, 49.7′ Fahr.

Named for Dr. Paul Bartsch of the U. S. National Museum.

Zoroaster ophiactis new species.

Diagnosis.—Closely related to *Zoroaster alfredi* Alcock, from which it differs in having longer rays, stouter, conical, carinal spines, relatively smaller papular pedicellariæ, ungrooved spinelets, less numerous adambulacral pedicellariæ, and in lacking, deep in the furrow, the 2 large bunches

of pedicellariæ characteristic of *alfredi*. R=282 mm., r=15.5 mm., R =18 r; breadth of ray at base, 17 mm. Disk very small, fairly level on top in large specimens, tumid in small; rays slender and strongly carinate, the carinal plates forming a definite spiniferous ridge. Between adradial plates (which have no central spine) and adambulacrals, 7 longitudinal series of plates at base of ray, each plate with a central conspicuous, slender, tapering, sharp spine, which on the 3 lowermost rows becomes flattened and appressed. Adambulacral armature: 1 spine deep in furrow with a terminal three-cornered sacculus with upward of 10 unequal, medium sized and small pedicellariæ, and above this a row of 3 or 4 spines bent outward, the third usually the longest; that above furrow spine with a large pedicellaria.

Type.—Cat. No. 37,008 U. S. N. M.

Type-locality.—Station 5606, Gulf of Tomini, Celebes, 834 fathoms, green mud, 1 specimen.

Zoroaster microporus new species.

Diagnosis.—Related to *Zoroaster barathri* Alcock, from which it differs in having squarish, instead of hexagonal carinal plates, smaller miliary spinelets, longer central spines on 5 lateral rows of plates (instead of on the 2 or 3 lowermost series only), more numerous pedicellariæ, in having 2 inner spines of the prominent adambulacrals with pedicillariæ (3 in *barathri?*), and in having 2 transverse series of spines on the actinal face of both sorts of adambulacrals. R=205 mm., r=12 mm., R=17 r; breadth of ray at base, 13 mm. Disk small, scarcely more than the united bases of the rays; rays long, slender, with a conspicuous, rounded unarmed carinal ridge, and a well-defined sulcus along either side; 5 series of lateral plates with a central spine; tube-feet biserial.

Type.—Cat. No. 37,009 U. S. N. M.

Type-locality.—Station 5637, 21 miles southwest Amblan Island (off Bouro Island), Moluccas (3° 53′ 20″ S., 126° 48′ E), 700 fathoms, gray mud.

Zoroaster carinatus philippinensis new subspecies.

Diagnosis.—Differing from *Zoroaster carinatus* in having more numerous adambulacral spines, with many more pedicellariae; less tumid apical plates, less prominent central spinelets to carinal plates; more numerous pedicellariæ generally. Disk small, rays long, slender, pointed, with a midradial ridge or carina; central spinelets of carinal plates slightly enlarged; 4 rows of slender appressed spinelets along side of ray (3 in small specimens); superomarginal and proximal inferomarginal plates without central spine (the latter sporadically with spine in *carinatus*); prominent adambulacral plates with transverse series of 6 or 7 spines (5 in small specimens), the inner 2 with several large and small pedicellariæ. R=194 mm., r=13.5 mm., R=14 r; breadth of ray at base, 14 or 15 mm.

Type.—Cat. No. 37,010 U. S. N. M.

Type-locality.—Station 5587, Sibuko Bay, Borneo, 415 fathoms, green mud, sand, coral; bottom temperature 42.3° Fahr.

Bythiolophus new genus.

Diagnosis.—In general structure resembling *Zoroaster*, except in the presence of superambulacral plates and in the arrangement of the abactinal skeleton. In this the adradial series is more prominent than the carinal, consisting of alternately larger and smaller, transversely elongated plates, the larger of which overlie the lateral third of the carinals; both sorts strongly overlap the upper end of the superomarginals. Two series of marginals and 4 series of intermediate plates. Adambulacral plates as in *Zoroaster*.

Type.—*B. acanthinus*, new species.

Bythiolophus acanthinus new species.

Diagnosis.—Rays 5. R=105 mm., r=13 mm. R=8 r; breadth of ray at base, 14 mm. Rays 4 sided, very gradually tapering; abactinal surface of ray sunken along median line except near tip, where the surface is nearly plane; sides forming a steep bevel; interbrachial arcs angular; radial plates sunken, but tumid, with a short, sharp, appressed spine; adradial plates prominent, forming margin of abactinal surface, larger and smaller alternating, the larger and some of the smaller with a central spine similar to the carinal spines; 6 lateral series of plates, each with a prominent central spine, the third and fourth from top the longest; prominent adambulacral plates with transverse series of 4 spines, and about 3 spinelets (on actinal surface), the inner with 1 to several pedicellariæ.

Type.—Cat. No. 37,011, U. S. N. M.

Type-locality.—Station 5648, Buton Strait, Celebes, 559 fathoms, green mud, bottom temperature, 39.2° Fahr.

Odinia penichra new species.

Diagnosis.—Rays 16, rather slender, the costal region extending about half the length of ray and containing 10 to 12 complete, rather weak, conspicuously spiniferous costæ, widely and nearly equidistantly spaced; disk with steeply beveled margin and conspicuous, terminally denticulate spinelets in ones and twos on its slightly convex plates; adambulacral armature with 1 slender aboral furrow spinelet and 1 actinal spine, proximally bifid; oral plates with 4 or 5 actinostomial spinelets, and 1 aboral furrow spinelet; no suboral spine. R=100 mm., r=7.5 mm. (to edge of disk), R=13.3 r; breadth of ray at base, 3.5 mm.; breadth of actinostome, 9 mm.

Type.—Cat. No. 37,019 U. S. N. M.

Type-locality.—Station 5217, between Burias and Luzon, 105 fathoms, coarse gray sand.

Brisinga trachydisca new species.

Diagnosis.—Rays 13 or 12; a multicostate form with the spinelets of disk in groups of 2 to 6, spaced like pseudopaxillæ; costæ 40–45, very prominent, irregular and sinuous, without intercostal bands of pedi-

cellariæ, and with relatively coarse spinelets, the costal region occupying more than a third of the total length of ray but less than one-half; adambulacral plates not crowded; armature with 1 aboral furrow spinelet, 1 adoral actinal spine, 1½ to 1¾ the length of the plate, and 1 prominent actinal spine 3 times the length of plate. Rays slender, very long; breadth of disk equals 4 to 4½ times width of ray at base.

Type.—Cat. No. 37,020, U. S. N. M.

Type-locality.—Station 5491, between Leyte and Mindanao, 736 fathoms, green mud, coral, bottom temperature 52.3° Fahr.

This species differs from *B. andamanica* in having more closely crowded costæ, with strongly, not feebly developed plates, in having a longer costal region, in lacking well-developed bands of pedicellariæ between the costæ and in having fewer (12 or 13, not 15), less deciduous rays. *B. gunnii* differs in having more numerous rays, much thinner disk, which has a downy appearance, only 20 to 30 ridges, especially prominent laterally but obsolete abactinally, intercostal bands of pedicellariæ, a much shorter major subambulacral spine, and mouth plates composed of 2 incompletely fused adambulacrals, leaving a "ligamentous symphysis between."

Brisinga mimica new species.

Diagnosis.—Rays 16. Costæ numerous (25 to 30), closely placed, prominent, irregular, with relatively coarse spinelets, without intervening bands of pedicellariæ; costæ confined to basal fifth of ray, beyond which for an equal distance are about 15 very inconspicuous ridges composed of small plates, but carrying a fairly heavy felting of pedicellariæ; disk large, with isolated delicate spinelets not in groups; adambulacral plates proximally wider than long and crowded in appearance; armature typically 1 aboral furrow spinelet, 1 aboral actinal spinule and 1 longer adoral actinal spine (equaling 2 plates in length), and 1 major spine about 3 plates in length. Rays slender, very long; R=385 mm., r=19 mm.

Type.—Cat. No. 37,021, U. S. N. M.

Type-locality.—Station 5648, Buton Strait, Celebes (5° 35′ S., 122° 20′ E.), 559 fathoms, green mud; bottom temperature 39.2° Fahr.

B. insularum has 13 rays and disk spinelets in groups, intercostal ridges of pedicellariæ, only 13 to 17 costæ, and longer lateral spines. *B. bengalensis* has 14 rays, a small disk, with the abactinal spinelets in tufts, 20 costæ, occupying basal ninth of the ray, intercostal bands of pedicellariæ equally salient with the ribs.

Brisinga moluccana new species.

Diagnosis.—Rays 16. Costæ 25, complete, prominent, well-spaced, with 1 to 3 intercostal bands of pedicellariæ; costal spinelets relatively coarse; disk medium, with isolated papilliform, small, spinelets, and minute pedicellariæ; adambulacral plates about as wide as long proximally; armature typically: 1 true furrow spinelet at either end of plate and equal to about ⅔ the length of plate; aborad and actinad to the

adoral spinelet is a shorter one generally pointed away from the furrow; the large actinal spine, equal to 2 or 3 plates in length, is situated on the aboral half of plate. Costal area swollen, occupying somewhat more than basal third of ray; integument thin, devoid of prickles. Breadth of disk equal 5 times width of ray at base (6 mm.). R=410 mm., r=15 mm.

Type.—Cat. No. 37,022, U. S. N. M.

Type-locality.—Station 5626, between Gillolo and Kayoa Islands, Molucca Islands, 265 fathoms, gray mud, fine sand.

Brisinga acanthogenys new species.

Diagnosis.—Rays 11. Costæ 20, complete, prominent, well spaced, with 1 complete and 1 or 2 incomplete bands of intercostal pedicellariæ; costal spinelets fairly prominent, few in number; disk *small*, with beveled margin; plates granuliform, spaced, with usually 2 or 3 very small spinelets but no pedicellariæ; lateral spines long, equaling length of 7 or 8 adambulacral plates; no integumentary prickles on rays; adambulacral plates about as wide as long proximally; armature, proximally: 1 true furrow spinelet at each end, 1 minor adoral subambulacral spinule a little longer than the plate, and a major subambulacral spine 3½ to 4 plates in length, situated on a prominence of the aboral half of the plate; mouth plates each with 2 suboral spines. Breadth of disk equal to 3½ times width of ray at base (6 mm.). R=350 mm., r=11 mm.

Type.—Cat. No. 37,023, U. S. N. M.

Type-locality.—Station 5440, mouth of Lingayan Gulf, Luzon, 172 fathoms, fine gray sand, globigerina; bottom temperature, 53.2° Fahr.

Craterobrisinga new subgenus.

Diagnosis.—Proximal adambulacral plates short, wider than long; the major subambulacral spines of proximal plates clavate, with enlarged capitate, often truncate tip. Type, *Brisinga panopla* Fisher.

This subgenus includes *B. panopla* Fisher, *B. alberti* Fisher, *B. cricophora* Sladen, *B. parallela* Koehler, besides the species described below.

Brisinga (Craterobrisinga) eucoryne new species.

Diagnosis.—Rays 11. Related to *B. alberti* Fisher. Five or 6 inconspicuous rudimentary costæ at base of ray, followed by 17 to 20 well-spaced prominent ridges occupying proximal third of ray; numerous small integumentary spinelets, and about 3 inconspicuous bands of pedicellariæ between the costæ, which are composed of elongate elliptical plates, usually not compressed, bearing 1 or 2 spinelets in center; disk small, with crowded, rather long, solitary spinelets giving a hirsute appearance; adambulacral plates proximally wider than long, with crowded armature; first dozen plates with the slenderer of the 2 subambulacrals often truncate and slightly flaring; typical armature; a true furrow spinelet at either end of the plate and 2 large actinal grooved

spines sometimes in a transverse series at middle of plate or in an oblique series; outer spine of first 10 plates with a flaring truncate tip, ending in numerous points; each mouth plate with 2 large pointed suboral spines. Breadth of disk equaling 3⅓ times width of ray at base (6 mm.). R= 205 + mm., r=10.5 mm. (small section from tip of ray missing).

Type.—Cat. No. 37,024, U. S. N. M.

Type-locality.—Station 5348, Palawan Passage, 375 fathoms, coral sand, bottom temperature, 56.4° Fahr.

Stegnobrisinga new subgenus.

Diagnosis.—Integument between the costal arches of ray strengthened by many close-set, mostly contiguous or sometimes overlapping papery plates of irregular form and conspicuous size, completely filling the interspaces; proximal subambulacral spines acicular, as in typical *Brisinga*. Type, *Brisinga placoderma*.

The numerous costæ will at once separate this subgenus from *Freyella*, which has a characteristic appearance, quite unlike that of *Stegnobrisinga*.

Brisinga (Stegnobrisinga) placoderma new species.

Diagnosis.—Rays 13 or 14. Costæ 35 to 40, close together and not very prominent; intercostal areas paved with close-set, irregular, often overlapping papery plates devoid of spinelets; costal arches fairly regular and parallel, opposite every adambulacral, or occasionally more frequent, but only every third to fifth with a lateral spine; disk with beveled border and with close-set isolated spinelets and conspicuous slender-jawed pedicellariæ; adambulacral armature variable, usually 2 furrow spinelets at each end of the furrow margin, or 1 aboral and 2 adoral about as long as the plate, and a subambulacral spine 2½ to 3 plates in length. Breadth of disk equal to 3½ to 4 times width of ray at base (8 mm.). Rays long.

Type.—Cat. No. 37,025, U. S. N. M.

Type-locality.—Station 5648, Buton Strait, Celebes, 559 fathoms, green mud, bottom temperature, 39.2° Fahr.

Freyella spatulifera new species.

Diagnosis.—Rays 14, not very long. Disk with a beveled margin, covered with a close, uniform nap of mostly solitary, delicate spinelets; disk plates not distinguishable. Genital region of ray short, slightly swollen, the spinelets in clusters of 2 to about 6 per plate. On all but basal fourth of ray there are low, transverse, parallel ridges, caused by the plates being slightly elevated, upon which the spinelets are more numerous than in the narrow intervening areas. These ridges resemble somewhat the costæ of *Brisinga*, but are much less prominent. A slender, needle-like spine on the side of every adambulacral, beginning with the eighth, increases in length until equal to about 6 or 7 adambulacral plates. Adambulacral armature at base of ray consists of 1 furrow spine-

let at each end of the plate and a third, longer one, above the aboral spinelet; on the actinal surface is a prominent subambulacral spine which on the first 15 plates is conspicuously spatulate, the broad lip being sometimes flat, sometimes scoop-shaped, sometimes grooved. The truncated end has, often, 2 or 3 knobs, and the part of the spine which is flattened decreases from about half to about a fifth, or even less, on the distal spines affected. Mouth plates each with 3 short spinelets on the actinostomial margin, and 2 on the distal furrow corner; suboral spine about as long as the first subambulacral, with a slightly flattened, sublanceolate tip, sometimes ending in 2 distinct, sharp points. R=135 mm. + r=9 mm.; breadth of ray at base, 4.5 mm.; length of genital region, 30–35 mm.

Type.—Cat. No. 36,747, U. S. N. M.

Type-locality.—Station 5668, 2° 28′ 30″ S., 118° 43′ E. (off Mamuju Island), 901 fathoms., gray mud.

This species which is characterized by the broadly spatulate, proximal subambulacral spines and the rudimentary, transverse, abactinal spiniferous ridges differs from *F. echinata* Sladen in lacking the conspicuous abactinal spines of the genital region, and from *F. insignis* Ludwig (from off Panama) in having differently formed proximal subambulacral spines. In *insignis* the spines usually end in 2 to 4 diverging prongs and are only exceptionally flattened to any extent, while the lateral spine is opposite every alternate adambulacral plate and there is only 1 small aboral furrow spinelet. *Freyella pacifica* Ludwig, which has the tip of the proximal subambulacral spines slightly enlarged, has the lateral spine and furrow spinelet as in *insignis*.

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PROCEEDINGS

OF THE

BIOLOGICAL SOCIETY OF WASHINGTON

A NEW BAT FROM PORTO RICO.

BY HARTLEY H. T. JACKSON.

The Biological Survey Collection contains 235 specimens of bats obtained by Mr. Alex Wetmore while engaged in field work in Porto Rico during the spring and summer of 1912. An examination of this material reveals two specimens of an undescribed form of *Eptesicus*, which I take pleasure in naming for the collector. The bat may be recognized by the following diagnosis:

Eptesicus wetmorei sp. nov.

Type.—Young adult ♂, alcoholic with skull removed, No. 179,142, U. S. National Museum, Biological Survey Collection, from Maricao (altitude 1375 feet), Porto Rico; collected May 29, 1912, by Alex Wetmore. Original number 900.

General characters.—Nearest to *Eptesicus cubensis* (Gray) from which it differs externally in its slightly larger size, relatively larger ears and longer tragi, and duller color. Skull slightly larger than that of *cubensis;* relatively wider interorbitally and through braincase. Molariform dentition heavy; much heavier than in *cubensis.*

Color.—Upperparts duller than in *Eptesicus cubensis;* about fuscous of Ridgway.* Underparts much paler than upperparts; near olive-brown, anteriorly, shading posteriorly into drab. Ears and membranes fuscous-black.

Measurements.—Type (measured in flesh by collector): total length, 97; tail vertebrae, 41; hind foot, 12. Type (measured by writer from specimen in alcohol): length of forearm, 46; length of tibia, 19.5; length of thumb, 8.5; length of ear from crown, 13; length of tragus, 7.5.

* Ridgway, R. Color standards and color nomenclature, 1912.

Skull of type: condylobasal length, 17.1; greatest length, 18.2; breadth of braincase, 8.5; interorbital constriction, 4.4; length of maxillary tooth row (including canine), 7; length of mandibular tooth row (exclusive of incisors), 7.8.

Remarks.—The Porto Rican brown bat needs critical comparison only with *Eptesicus cubensis* from which it can be separated by the diagnosis above given. A male topotype (skin and skull, No. 179,230, U. S. National Museum, Biological Survey Collection) is immature, but as far as is determinable bears all the characters of the type.

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PROCEEDINGS

OF THE

BIOLOGICAL SOCIETY OF WASHINGTON

A LIST OF THE FISHES OF THE SENECA CREEK, MONTGOMERY COUNTY, MARYLAND, REGION.*

BY LEWIS RADCLIFFE AND W. W. WELSH.

The present paper is based upon collections of fishes from the Chesapeake and Ohio canal near Rushville, Maryland, and from Little Seneca and Tenmile creeks near Boyds, Maryland, December 12 to 14, 1911. The authors accompanied one of the parties of the United States Bureau of Fisheries engaged in reclaiming the food fishes from the canal. This party seined a section of the canal about six miles in length from a point near Sycamore Island in the Potomac River up to Tenfoot Island. Large quantities of fish were hauled ashore with the seine and thousands of food fish which would have perished if left in the canal were carried over the bank and released in the Potomac River. As many of these were breeders, the fish supply of this section of the river was considerably augmented. Under these conditions, exceptional opportunities were afforded for gathering data as to the species occurring in this region and their relative abundance. Many of the fishes congregated in the deeper holes, especially in the basin or widewater in the canal above Rushville. About half a mile below Rushville, there is a lock locally known as Violett's Lock. A feeder from the river enters the canal below the lock, affording a means of ingress for the fishes of this section of the river. As the section above the lock is fed from a point much higher up and as the lock acts as a partial barrier, differences in the fauna of the two sections existed. Now that the fish from both sections are being released into this part of the river, these differences may

* Published with the permission of the United States Commissioner of Fisheries.

disappear. In June and September, 1914, the junior author thoroughly seined a section of Little Seneca and Tenmile creeks, near Boyds, Maryland. These are branches of Seneca Creek, which empties into the Potomac River at Rushville.

Because of the proximity of the Seneca basin to the streams about Washington, D. C., the present paper may be of interest to those interested in the distribution of the species of this region. The list contains 34 species from the vicinity of Rushville, all but one being from the canal, and 19 species from Little Seneca and Tenmile creeks. Of the 41 species listed, 12 were common to the two regions, as follows:

Schilbeodes insignis	Notropis photogenis amœnus
Catostomus commersonii	Hybopsis kentuckiensis
Hypentelium nigricans	Anguilla rostrata
Semotilus atromaculatus	Lepomis auritus
Pimephales notatus	Micropterus dolomieu
Notropis analostanus	Boleosoma olmstedi

The following species were found only in Little Seneca and Tenmile creeks:

Semotilus corporalis	Rhinichthys atronasus
Notropis cornutus	Exoglossum maxillingua
Rhinichthys cataractæ	Etheostoma flabellare

Uranidea gracilis

Without exception, these species are characteristic of the smaller streams, usually inhabiting the swifter creeks and brooks.

McAtee and Weed (Proc. Biol. Soc. Washington, Vol. XXVIII, 1915, p. 6) list 27 species from the Chesapeake ahd Ohio canal between locks 11 and 12. Of these, all but four were taken in the section seined near Rushville and eleven additional species, as follows:

Ictalurus furcatus	Notropis procne
Moxostoma macrolepidotum	Notropis analostanus
Carassius auratus	Hybopsis kentuckiensis
Hybognathus nuchalis	Fundulus diaphanus
Pimephales notatus	Percopsis omiscomaycus

Micropterus salmoides

Of these, *Moxostoma macrolepidotum* was very abundant and *Hybognathus nuchalis* and *Pimethales notatus* were common.

Annotated List of Species.

Siluridæ.

1. **Ictalurus punctatus** (Rafinesque).

This species has been introduced into the Potomac River below Great Falls and is apparently rare above the falls. Among the fish seined from the canal, only a single example, 134 mm. long, was seen.

2. **Ictalurus furcatus** (Le Sueur).

A single example, 555 mm. long, was obtained in the canal above Violett's lock. The unusual conditions to which this specimen was exposed serves to illustrate the remarkable vitality of catfishes. It was captured about 10.00 A. M., December 13, carried in a cart without covering during the remainder of the day and in the evening placed in a live box filled with carp. On the morning of the 14th it was lying on top of the carp, out of the water, showing no signs of activity; on the morning of the 15th it was active. Being too large for our collecting cans, it was wrapped in a newspaper, packed in a grip and thus carried to Washington. In the afternoon, when unpacked, it appeared about as lively as when first captured.

3. **Ameiurus nebulosus** (Le Sueur).

Abundant in the canal.

4. **Schilbeodes insignis** (Richardson).

This species is common in Tenmile Creek, near Boyds, apparently being most abundant in the autumn. Examples up to 112 mm. in length were collected. In the canal four small examples were taken at a point below the lock, locally known as Buzzards Hole.

Catostomidæ.

5. **Catostomus commersonii** (Lacépède).

Sparingly common in the canal. The young are common in Little Seneca and Tenmile creeks. Those taken in the creeks in June, 1914, may be arranged according to length into two groups, the first of specimens 27 to 35 mm. long and the second of specimens 80 to 165 mm. in length. The latter are believed to belong to the stock of the previous year.

6. **Hypentelium nigricans** (Le Sueur).

Adults were abundant in the canal and the species also occurs in abundance, especially the young, in Little Seneca and Tenmile creeks. On June 6, 1914, many examples ranging in length from 25 to 140 mm. were taken in the latter region.

7. **Erimyzon oblongus** (Mitchill).

Abundant in the canal. A male 330 mm. long had three tubercles on each side of snout. Color in life: back, brownish, crossed by nine blackish saddles of about width of three rows of scales; sides, brown with silvery and golden shades; belly, silvery white; body scales margined

with light golden color; fins, reddish, narrowly margined with dusky black; dorsal, caudal and anal with dusky mottlings. McAtee and Weed (Proc. Biol. Soc. Wash., Vol. XXVIII, 1915, p. 10) state that the species is rare in river and canal.

8. **Moxostoma macrolepidotum** (Le Sueur).

Very abundant in canal in this region. Three examples ranged in length from 238 to 355 mm.

CYPRINIDÆ.

9. **Cyprinus carpio** (Linnæus).

Common in the canal. Two of the largest were 650 and 800 mm. in length. This species is very tenacious of life if handled in such a manner that the gills are not injured, but bleeds to death very quickly, even from a slight abrasion. Carp seined from the canal were not returned to the river but were saved by the seiners for food, the most of them to be salted for winter use. Fish thus taken were carried in sacks in a wagon during the day and in the evening were packed in a live car placed in the bed of a small stream, some of them being above the water level. The number that died under this treatment was surprisingly small.

10. **Carassius auratus** (Linnæus).

Not uncommon in the canal. Of eight examples examined, the largest, 300 mm. in length, was black and dull orange. One was a uniform bright red, the others dusky silvery.

11. **Hybognathus nuchalis** Agassiz.

Common in the canal, the largest being 105 mm. in length.

12. **Semotilus corporalis** (Mitchill).

Common in Little Seneca and Tenmile Creeks.

13. **Semotilus atromaculatus** (Mitchill).

No examples were taken in the canal. Three, 93 to 163 mm. long, were seined in a small rivulet near the canal. In Little Seneca and Tenmile creeks, the species is abundant. Examples taken in June ranged in length from 50 to 115 mm., and small examples taken in September were 40 to 45 mm. long.

14. **Notemigonus crysoleucas** (Mitchill).

Abundant in canal, especially at a point locally known as Buzzards Hole; none taken in upper stretches of Seneca Creek.

15. **Pimephales notatus** (Rafinesque).

Common in the canal; abundant in Little Seneca and Tenmile creeks.

16. **Notropis procne** (Cope).

Apparently rare in the canal.

17. **Notropis hudsonius amarus** (Girard).

Abundant in the canal.

18. **Notropis analostanus** (Girard).

Apparently rare in the canal and in Little Seneca and Tenmile creeks.

19. **Notropis photogenis amœnus** (Abbott).

Very abundant in the canal, the largest being 92 mm. long. Two examples were taken in Tenmile Creek.

20. **Notropis cornutus** (Mitchill).

Abundant in Little Seneca and Tenmile creeks. Specimens taken in June ranged in length from 48 to 110 mm.

21. **Rhinichthys cataractæ** (Cuvier & Valenciennes).

Common in Little Seneca and Tenmile creeks. Examples taken in June may be grouped into two classes according to length, the first 24 to 27 mm. long, the second 66 to 82 mm. long.

22. **Rhinichthys atronasus** (Mitchill).

Abundant in Little Seneca and Tenmile creeks.

23. **Hybopsis kentuckiensis** (Rafinesque).

Several examples taken in the canal and in Tenmile Creek.

24. **Exoglossum maxillingua** (Le Sueur).

A single example taken in Tenmile Creek.

ANGUILLIDÆ.

25. **Anguilla rostrata** (Le Sueur).

Two examples from canal and one from Tenmile Creek.

DOROSOMATIDÆ.

26. **Dorosoma cepedianum** (Le Sueur).

Very abundant in the canal widewater above Rushville. Large schools were seen, more than a thousand adults being taken at a single haul of a 100 foot seine. The largest was 340 mm. long.

PŒCILIIDÆ.

27. **Fundulus diaphanus** (Le Sueur).

An adult taken in the canal below Violett's lock and a young example in a small pond above the lock.

PERCOPSIDÆ.

28. **Percopsis omiscomaycus** (Walbaum).

Very abundant in the canal at a point locally known as Buzzards Hole, the larger examples ranging in length from 85 to 126 mm. Although the canal was seined for a distance of about 6 miles above this point, no examples were taken at other points. The only other record for this species in the vicinity of Washington is that of Smith and Bean (Bull. U. S. Fish Com. for 1898, 1899, p. 185) from Rock Creek and Cabin John Run.

CENTRARCHIDÆ.

29. **Pomoxis annularis** Rafinesque.

Adults abundant in the canal widewater above Rushville. Over 1600 were rescued and liberated in the Potomac River. The largest one measured was 330 mm. long, but others which it is believed exceeded this length were seen. In over 100 examples examined the number of dorsal spines was 5 or 6, with two exceptions in which it was 7. McAtee and Weed (Proc. Biol. Soc. Wash., Vol. XXVIII, 1915, p. 12) state that this species and *P. sparoides* "are about equally common and occur both in the river and canal." Among the large number seined at this point, not a single example of the latter species was observed.

30. **Ambloplites rupestris** (Rafinesque).

Not uncommon in the canal. Examples from the point locally known as Buzzards Hole were of a very light silvery color, some of them showing scarcely any traces of black mottlings and with the size of the black opercular blotch greatly reduced. When placed in alcohol, these assumed the characteristic markings.

31. **Chænobryttus gulosus** (Cuvier & Valenciennes).

Abundant in the canal, more than 1,300 being rescued. Among those taken was an individual which appears to be a hybrid with *Lepomis gibbosus*. This has been described by the senior author (Copeia, No. 7, New York, June 20, 1914).

32. **Lepomis cyanellus** (Rafinesque).

Small examples abundant in the canal. This introduced species is rapidly gaining a foothold throughout the region about Washington, apparently preferring ponds, muddy, slow-moving streams, canals and the like.

33. **Lepomis auritus** (Linnæus).

Common in the canal and abundant in Little Seneca and Tenmile creeks.

34. **Lepomis gibbosus** (Linnæus).

Common in the canal. Over 3,000 of the three species of *Lepomis* were rescued in this region.

35. **Micropterus dolomieu** (Lacépède).

Common in the canal below Violett's lock, but greatly outnumbered above the lock by *M. salmoides*. According to local fishermen *dolomieu* greatly outnumbers *salmonoides* in the Potomac along this stretch of the canal, while farther up the river, below Harpers Ferry, the reverse is true. The feeder from the Potomac enters the canal below the lock and the small-mouthed bass may have entered in this manner, while above the lock the fish entered through a feeder from a point much higher up, where the large-mouthed bass predominates. Now that both species are being liberated in the Potomac in this region, this condition may be changed. Two examples were taken in Tenmile creek.

36. **Micropterus salmoides** (Lacépède).

Common in the canal above Violett's lock. As fast as the food fishes were seined from the canal, they were carried over the bank in buckets and liberated in the Potomac. One large bass, when released from the bucket in company with other varieties, instead of darting out into the river, seized and swallowed head foremost a small crappie which had been carried over with it. The fish did this within a few feet of the person releasing it. Over 1,100 bass (two species) were rescued from this section of the canal, many being adults.

PERCIDÆ.

37. **Perca flavescens** (Mitchill).

Not uncommon in the canal, mostly small.

38. **Boleosoma olmstedi** (Storer)

Not uncommon in the canal and in Little Seneca and Tenmile creeks.

39. **Etheostoma flabellare** (Rafinesque).

Abundant in the Little Seneca and Tenmile creeks.

SERRANIDÆ.

40. **Morone americana** (Gmelin).

Common and of large size in the canal widewater above Rushville. Over 600 were rescued.

COTTIDÆ.

41. **Uranidea gracilis** (Heckel).

Abundant in the upper waters of Little Seneca and Tenmile creeks. Specimens taken in June ranged in length from 22 to 85 mm.

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PROCEEDINGS

OF THE

BIOLOGICAL SOCIETY OF WASHINGTON

GENERAL NOTES.

NOTE ON THE INDIGENOUS RODENT OF SANTO DOMINGO.

Hitherto the only known specimen of the indigenous rodent of Santo Domingo has been the type, sent to Paris by Ricord, and described as a new genus and species, *Plagiodontia ædium*, by F. Cuvier in 1836.* The discovery of three left lower mandibles (one with dentition complete), a tibia, and part of a pelvis among some miscellaneous bones taken by W. M. Gabb from a kitchen midden in a cave on the shore of San Lorenzo Bay, Santo Domingo, 1869–71, is therefore of much interest.† Two of the mandibles represent adult individuals, while the third is not mature. Some of the measurements of the two adults (Nos. 200,411 and 200,412 U. S. National Museum) are: length from projection behind articular surface to posterior border of alveolus of incisor, 48, 50; depth through articular process, 24.0, 24.6; diastema, 11, 13; toothrow (alveoli), 19.0, 20.2; first lower molar (alveolus), 4.4 x 4.4, 5.0 x 5.0. In both of the adults the teeth were still growing from a basal pulp, so that the enamel pattern undergoes no change at successive levels from crown to base. The pattern is correctly represented by Cuvier (pl. 17, fig. 5); it is identical in character with that of *Adelphomys* from the Santa Cruz beds of Patagonia as figured by Ameghino ‡ and Scott.§ The upper cheek teeth as figured by Cuvier (pl. 17, fig. 4) are equally like those of a Santa Cruz specimen regarded by Scott (pl. 65, fig. 13) as representing the maxillary dentition of *Scleromys* Ameghino, a genus based on lower teeth differing widely from those of *Adelphomys* and *Plagiodontia*. The exact meaning of the discrepancies can not now be explained. These conclusions, however, seem justified: that *Plagiodontia* is not closely related to *Capromys*, and that the occurrence of these two genera and of *Amblyrhiza* in the West Indies during relatively recent times indicates the probability of a once-abundant Antillean representation of the Hystricine group.

—*Gerrit S. Miller, Jr.*

* Ann. Sci. Nat., Paris, ser. 2, vol. 6, p. 347.

† The cave and kitchen midden are described in Gabb's account of the topography and geology of Santo Domingo. Trans. Amer. Philos. Soc., n. s., vol. 15, pp. 146–147. 1873.

‡ Mam. Fos. Argent., pl. 6, fig. 3 c.

§ Rep. Princeton Univ. Exped. Patagonia, vol. 5 (paleont. 2), pl. 65, fig. 21.

REMAINS OF TWO SPECIES OF CAPROMYS FROM ANCIENT BURIAL SITES IN JAMAICA.

While the indigenous Antillean rodents of the genus *Capromys* are represented by several species in Cuba, only one, *C. brownii* Fischer, has hitherto been found in Jamaica. Two distinct members of the genus are each represented by a toothless mandible and two femurs taken from ancient burial sites near Salt River, Jamaica, by R. C. McCormack and now in the U. S. National Museum. One of these is identical with the known living Jamaican species. The other, differing from *Capromys brownii* in conspicuously smaller size (greatest length of femur without epiphysis about 56 mm. instead of about 68 mm., lower toothrow 16.4 instead of 19.4) and in the obviously reduced condition of the third lower molar, I am unable to distinguish from *C. thoracatus* (True) of Little Swan Island. Whether or not this apparent identity is due merely to the incompleteness of the individuals represented by the Jamaican specimens, and what such identity might mean should it ever be proved to exist, are questions that can not now be answered; but in any event the discovery of these smaller bones in Jamaica is an interesting fact.

—*Gerrit S. Miller, Jr.*

THE FIRST NEW ZEALAND CRINOID.

Prof. William B. Benham, of the University of Otago, Dunedin, New Zealand, has been so kind as to submit to me for determination the first crinoid ever discovered in New Zealand waters.

It was collected by Mr. Percy Seymour from a row-boat in about 15–20 feet of water at Preservation Inlet on the west coast of the South (or Middle) Island. Three specimens in all were secured.

Of the fauna of Preservation Inlet Professor Benham writes: "From the same locality some Hydrocorallines and Antipatharians were obtained, and a Pennatulid, all of which are 'Australian' in their affinities. The fauna of the west coast of New Zealand is little known, but it differs considerably from that of the east, south, or north coasts of the island. The west coast is difficult to get at and is only sparsely inhabited, and few of us naturalists have been able to collect there except very superficially and sporadically, as boats only visit Preservation Inlet very irregularly, and once there one never knows how long one might be compelled to stay, as there is no road across the forest clad mountains."

It is interesting to note that this crinoid belongs to a species characteristic of, and confined to, southern and southeastern Australia and Tasmania, *Comanthus* (*Cenolia*) *trichoptera* (J. Müller).*

The twenty-eight arms of the specimen sent by Professor Benham are 115 mm. long; the centrodorsal is large, thick-discoidal, the dorsal pole broad and flat, with the centre depressed; the cirri are XL–L, 24–27 (usually 26–27), 22 mm. to 25 mm. long.

The relatively long cirri, which are composed of more numerous segments than the cirri of the typical form, would appear to indicate that this specimen represents a recognizable variety, probably peculiar to New Zealand, for which I propose the name *Comanthus trichoptera* **benhami**. The type specimen is the property of the University of Otago.

—*Austin H. Clark.*

* See "Recent Crinoids of Australia," Sydney, 1911, p. 755.

IDENTIFICATION OF A SUPPOSEDLY ANOMALOUS ECHINODERM.*

In 1902 Dr. Hubert Lyman Clark described, under the title of "An Extraordinary Animal,"† a very curious creature, evidently an echinoderm, which he was unable to place satisfactorily. He says that "it probably is an echinoderm, but whether an echinoid or a holothurian I am unable to decide * * * The whole external appearance of the lower part of the animal is * * * quite similar to the body of the holothurians, *Sphærothuria* or *Echinocucumis*. But the spines when examined under the microscope appear more like echinoid spines * * * There can be little doubt that the specimen is a monstrosity, but of what? My own opinion is that it is a holothurian, related to *Sphærothuria*, but the spines and the 'digestive tube' (?) are very much like those of an echinoid.—The most puzzling question to me is, how did an animal with apparently no mouth or anus and no means of locomotion reach such a considerable size?"

The specimen is preserved in the U. S. National Museum (Cat. No. 19,899) and, as it seemed to me desirable to identify it positively if possible, I recently undertook an independent study of it.

As Doctor Clark's description is not quite accurate in certain details, I offer the following supplementary notes.

General Form.—The specimen is composed of two quite distinct portions, a larger, ovoid in outline with the greater diameter 13 mm. and the lesser 11.5 mm., in end view circular, 11.5 mm. in diameter; and a smaller, broken away on one side, consisting of a very irregular half cylinder with the ends more or less in-curved, measuring 12 mm. in length and 5.5 mm. in width, which is attached to one side of the larger part in the direction of the longer axiis, nearer the smaller than the larger end. The border of the larger part opposite the attachment of the smaller is slightly flattened.

Covering of the Larger Part.—The larger portion is entirely enclosed in irregular polygonal plates of various sizes, each of which bears from one to six (usually from one to three) jointed spines, and a few in addition a pedicellaria, which superficially resembles a short, small rounded-conical spine. The spines, most of which are broken, appear to be cylindrical, with a more or less abrupt conical tip. Within the area delimited by the smaller part and the missing portion the investment consists of a smooth pavement of very irregular polygonal plates which are somewhat smaller than those of the free wall.

Covering of the Smaller Part.—The smaller portion is composed, insofar as it is preserved, of six columns of narrow elongate plates which carry long spines, longer than the spines on the surface of the larger part, in a single median row, but no pedicellariæ. The six columns are webbed by perisome, which may carry a few additional plates. Extending laterally from the first and sixth of these columns are two horizontal rows of

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† Zool. Anzeiger, vol. **25**, 1902, pp. 509–511, fig. p. 510.

similar plates, the more distal of which lie about half way from the base to the outer edge of the entire smaller portion as viewed laterally. On both sides the surface is torn away in the angle between the outermost of the vertical columns, and the uppermost of the horizontal rows. To the left the horizontal rows terminate in a torn edge; to the right they become lost in a maze of plates similar to those of the surface of the larger portion.

Inner Structure of the Larger Part.—The larger portion is a completely enclosed sac, showing no evidence of communication either with the exterior or with the interior of the smaller portion. Within it I can find nothing but a thick irregular lining of connective tissue, on the surface of which is an elongate depression, evidently mistaken by Dr. Clark for the lumen of a digestive tube.

Inner Structure of the Smaller Part.—The interior of the smaller portion is mostly occupied by gonads, lying along its longer axis. But I also found a relatively large sac-like structure and part of another near the broken end of the columns.

Identification of the Specimen.—The features which offer the greatest possibilities for the determination of the specimen are (1) the arrangement of the plates on both the larger and the smaller portions, (2) the character and distribution of the spines, and (3) the character and distribution of the pedicellariæ.

The pedicellariæ are of the type found in the Brisingidæ.

The arrangement of the plates on the larger portion and the distribution of the spines and of the pedicellariæ on these plates, as well as the character of the spines, are identical with the same features in certain species of *Brisinga*.

The arrangement of the columns of plates in the smaller portion, and the character of these plates and of the spines which they bear, are exactly duplicated in the arm bases of certain species of *Brisinga*.

Furthermore the gonads, which are very *Brisinga*-like, lie in the same relation to these plates that they do to the dorsal arm plates of the species of *Brisinga;* and the sac-like structures are very like the rather large *Brisinga* ampullæ.

As all the tangible characters of the specimen are identical with comparable characters in the genus *Brisinga*, and are not duplicated in any other genus of echinoderms, least of all in the echinoids and holothurians, it seems evident that we are dealing with a large cyst-like outgrowth from the base of a *Brisinga* arm.

A large species of *Brisinga*, in its details agreeing perfectly with comparable features of the specimen, was taken at the same dredge-haul; furthermore, many of the specimens of this *Brisinga* bore cyst-like outgrowths on the arm bases containing a curious type of degenerate mollusc.

There can be not the slightest doubt that this supposedly anomalous echinoderm type is merely a detached cyst, with part of the dorsal surface of the arms and the underlying gonads, from the species of *Brisinga* dredged at "Albatross" Station 3342, from which the parasite has been removed. —*Austin H. Clark.*

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PROCEEDINGS

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SIX NEW STARFISHES FROM THE GULF OF CALIFORNIA AND ADJACENT WATERS.*

BY AUSTIN H. CLARK.

The zoögeographic region which extends from Peru northward to and including the Gulf of California and the southern portion of the Pacific coast of the peninsula of Lower California is very remarkable not only on account of the relatively large number of peculiar genera which occur therein, but also because of the curious relationships which the endemic species show to others in southeastern Australia, the Hawaiian Islands, the Mediterranean, and the Caribbean Sea, in addition to their relationships with types occurring in Oceania and in the Malayan region.

A considerable amount of work has been done here, both by shore collectors and, in deep water, by the "Albatross"; yet it is clear that there is still a great amount to be accomplished, for many types which should occur here are as yet unknown, while others have not been seen since they were first recorded, some of them more than half a century ago.

Of the six species herein described *Sideriaster canaliculatus* is related, more or less closely, to *S. grandis*, known from a single specimen from the Gulf of Mexico; *Saraster insignis* is related to other types in the eastern north Pacific; *Anthenea mexicana* is related, though not very closely, to other species of the genus in Australia, India and China; *Narcissia gracilis* is related to two Atlantic forms, one of which occurs in the Gulf of Mexico; *Echinaster parvispinus* is related to other species of the genus in the Malayan region; while *Cyllaster seminuda* finds its nearest counterpart in the Hawaiian Islands.

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These new species will be figured and further discussed in a paper dealing with the fauna of the region based upon the recently determined material in the U. S. National Museum, where figures of such rare forms as *Acanthaster ellisii* (Gray) and *Leiaster teres* Verrill, which the Museum also possesses from the Gulf of California, will also be included.

Family ASTROPECTINIDÆ Gray.

Sideriaster canaliculata new species.

Five arms; R=64 mm.; r=19 mm.; R:r=3.4:1; width of ray at base (measured from the interradial line) 22 mm.; superomarginals 45.

General form stellate; disk medium sized; rays tapering evenly to a blunt extremity.

Gonads confined to the interradial portion of the disk, not extending out along the rays.

There are well developed superambulacral plates.

The paxillæ are closely placed, though not crowded, and are remarkably uniform in size, those adjacent to the superomarginals being only slightly smaller than those in the radial line of the arms, and the latter similarly only slightly larger than those in the center of the disk.

A large paxilla from the radial region at the base of the arms has a rather low thick stalk supporting a crown consisting of from six to ten (most commonly seven, rarely more than eight) stout blunt radiating spines, with frequently one or two (rarely more) additional much smaller and shorter spines between them, and from one to four (most commonly one or two) short stout round-tipped spines, resembling the radiating spines but shorter, at the summit. The radiating spines are about as long as the column of the paxilla is high.

The large prominent exposed madreporite is situated exactly midway between the center of the disk and the interbrachial margin. It is circular, 3.5 mm. in diameter, and bears numerous more or less complete septa extending from the periphery a greater or lesser distance toward the center. It presents a most striking similarity to a coral polyp.

Papulæ, regularly six about each plate, occur uninterruptedly across the arms.

The superomarginals are short and broad; in the interbrachial arc they are wedge-shaped, about half as long at the actinal as at the abactinal end, 5 mm. wide and 1 mm. long at the well rounded abactinal border; they are evenly curved, the arc of the curvature making an angle of about 60° with the plane of the disk; gradually they become more oblong and increase in length to the fifth and following, which have parallel sides and are noticeably larger than those in the interbrachial arc; on the arms they become more recumbent, lying mostly on the abactinal surface, though still with a uniform curve from the actinal to the abactinal border.

The superomarginals bear on their outer surface usually three (some-

times two or four) alternating rows of short stubby well spaced truncated spines which increase slightly in diameter from the base to the broad nearly flat tip, and are about as high as, or slightly higher than, their basal diameter; in the interbrachial arc there are about twelve of these spines to a row, and on the outer part of the arms eight or nine; those in the median row are slightly larger than those in the lateral rows. The channels between the superomarginals are filled with very numerous short very slender spinelets which are almost or quite concealed from view by the outermost rows of spines on their outer surface.

The line of union between the superomarginals and the inferomarginals is slightly sunken.

The inferomarginals correspond to the superomarginals, which in general they resemble; but in addition to the armature as described for the latter they possess on the outer border of the actinal surface, or more or less below the middle of the plate, a broad extremely flattened truncated spatulate spine from 1 mm. to 1.5 mm. in length, about half as broad as long or even shorter, increasing more or less in length from the base to the tip, with more or less convex sides. In the interbrachial arc there may be two or even three of these spines to a single inferomarginal; beyond the proximal third of the arm they become smaller, at the middle of the arm being but little larger than the short spines covering the outer surface of the plate, soon after disappearing altogether.

The actinal intermediate areas are moderate in size; the plates are arranged in regular series running from the inferomarginals to the corresponding adambulacrals; an unpaired line of plates runs from the mouth plates about half way to the marginals. A single series of actinal intermediate plates extends to the twentieth inferomarginal, a second to the twelfth, and a third to the seventh. These actinal intermediate plates are narrow, with deep channels between the rows which are filled with small slender spinules similar to, but fewer and coarser than, the spines filling the channels between the marginals. Each plate bears on its actinal surface usually from four to eight short truncated spines, similar to those on the marginals but more spaced, and of various sizes instead of uniform, or nearly uniform, size. All of the plates bordering the adambulacral and mouth plates, and a few of the others, bear pedicellariæ, usually with three or four jaws.

The adambulacral plates bear on their sharply angular furrow margin three broad and strongly flattened spines. The innermost of these, situated at the apex of the angle, is slightly recurved, and is flattened transversely to the furrow; the spines on either side of this are straight, slightly less broad, and the axis of their flattening is parallel with the edge of the plate so that they make an angle of 30° with the axis of flattening of the median spine, or of 60° with each other. Behind these is a row of two or three similar flattened spines, the axis of the flattening being parallel with the furrow; but one or both of the outer of these may turn more or less so as to form supplementary furrow spines, and the central one may become enlarged, especially toward the end of the ray. Beyond these is a row of two similar, but smaller spines. The grooves

between the plates are filled with slender spines resembling those in the grooves between the marginals.

The mouth plates are narrow; the furrow margin is short, with apparently five flattened spines which decrease in length outwardly and resemble those of the furrow series on the adambulacrals, but are more slender; the margin adjoining the adambulacrals bears five or six much shorter spines of diminishing length ; just within these there are five or six longer and stouter spines, also of diminishing length. The sutural edge bears three or four long spines corresponding to and resembling those on the distal furrow margin, abruptly changing to a series of much smaller spines before the maximum width of the plate is reached. The edge bordering the adambulacrals bears very numerous short fine spines like those bordering the adambulacrals.

Color in alcohol, brownish yellow.

Type.—Cat. No. 36,951, U. S. N. M., from "Albatross" Station 2998, Gulf of California, in 40 fathoms.

Family BENTHOPECTINIDÆ Verrill.

Saraster new genus.

Genotype.—*Saraster insignis*, new species.

The characters of this genus are given in the description of the type species following.

Saraster insignis new species.

Five arms; R=100 mm.; r=10 mm. (actinally) to 12 mm. (abactinally); R: r=8.3 to 10 : 1 ; width of ray at base (between odd interradial marginals) 15 mm. ; superomarginals 46.

General form stellate; rays broad at the base, tapering rather rapidly in the first quarter, much less rapidly from that point onward ; odd interradial marginals are present in both series in all interradii.

The gonads reach the fifth or sixth superomarginal.

The pedicels have well developed, though small, sucking disks.

The interbrachial septum is very small, membranous.

The dorsal muscle bands are not attached to a proximal ambulacral ossicle.

There are no pedicellariæ.

The abactinal plates are strongly stellate, large and small intermingled, the large with a low tabulum. Each abactinal plate bears usually one, on the disk sometimes two, rarely three, long rough spines which have numerous longitudinal serrate ridges; in the center of the disk the spines may reach 5 mm. in length; along the mid-line of the arms they remain of the same length until the end of the basal quarter, though they become more slender; beyond this point, and along the sides of the arms, they are shorter and more slender, but the transition from the longer to the shorter spines is always very gradual. If there is more than one spine to a plate, they are usually of very different sizes. The plates of the disk

and arm bases commonly have from three to six very small spines of different sizes about the bases of the larger.

The papulæ are large, abundant, and conspicuous, occurring all over the abactinal surface to within 20 mm. of the tips of the arms; they are slightly smaller in the mid-radial line of the arms and in the center of the disk than elsewhere.

The madreporite is oval, measuring 4 mm. by 3 mm., the longer diameter radial; the surface is elevated, high, evenly convex, covered with numerous fine irregular ridges; its center is one-third of the distance between the odd interradial superomarginal and the center of the disk.

The odd interradial superomarginal is six sided; the abactinal and the two adjacent sides are of about the same length; the former is slightly concave, and the two latter are produced into a slight spine at the lower angles; the proximal border, adjoining the odd interradial inferomarginal, is about as long as the opposite side, straight, or slightly convex; the two lower lateral sides are about twice as long as the others, slightly concave. The abactinal surface of the plate within the outer face is produced into a rounded tubercle, not especially conspicuous, which bears on its outer side (not on its summit) a rough spine only slightly larger than the large spines of the disk, directed outward and more or less downward.

The superomarginals are low and long, mostly about twice as long as broad; the first is irregularly polygonal or quadrate, about as long as broad; the following are irregularly rhombic with the distal and proximal angles truncated; the suture between the adjacent superomarginals slants strongly inward, the abactinal end being more distal than the actinal. Each superomarginal bears in its upper two-thirds, springing from a common elevation, two slender spines, one directly above the other; the uppermost is the longer, resembling the long spines of the center of the disk but somewhat more slender; the lower is shorter and more slender; in the outer half of the arms the latter disappears. The common elevated base bearing these spines carries a few spinules.

The odd inferomarginal is elongated dorso-ventrally; the actinal third lies on the actinal surface, while the abactinal two-thirds stands almost vertically, forming with the corresponding superomarginal the side wall of the interbrachial arc. Viewed laterally the odd interradial inferomarginal appears six-sided; the actinal side, forming the border between the actinal and abactinal surfaces, is about twice as long as the other sides, which are all of equal length; that part of the plate which lies on the actinal surface is approximately semicircular, with two slight tubercles midway between the midradial point and the point of union with the adjacent inferomarginals. The plate bears a vertical median column of three slender spines of which the uppermost, situated in the center of the lateral surface, is 3 mm. long; the next, situated on the lateral surface just at the actinolateral border, is of about the same size; the third, situated just beyond the center of the actinal surface, is much smaller.

At first the inferomarginals are slightly displaced distally, but after the proximal fourth of the arm they correspond to the superomarginals; in the proximal fourth of the arm they resemble the superomarginals in

size and shape, but distally they are somewhat smaller. The upper border of the inferomarginals imbricates slightly over the lower border of the corresponding superomarginals. Each inferomarginal bears two spines, which are similar to those borne by the superomarginals.

The actinal intermediate plates are two (rarely three) in number, rounded, suspended in perisome just beyond the two tubercles on the inner border of the odd interradial marginals, or just distal to the outer angles of the mouth plates.

The adambulacral plates are slightly longer than broad; their distal and proximal borders are parallel, oblique, slanting adorally toward the furrow; the furrow border forms a prominent angle with a rounded apex and concave sides. The first adambulacral plate is separated from the odd interradial inferomarginal by the actinal intermediate plate; the second adjoins the first inferomarginal; the third lies across the suture between the first and second inferomarginals; from this point onward the adambulacrals, slightly more numerous than the inferomarginals, sometimes correspond, sometimes alternate, with them. The armature consists of two, rarely three, small slender spines situated side by side at the apex of the angle on the extreme inner edge well within the furrow; behind these, on the inner edge of the plate as viewed actinally, a much larger spine, resembling those on the inferomarginals, though very slightly smaller and less stout.

The mouth plates bear three long spines along the furrow which decrease rapidly in size outwardly; on the actinal surface of the plates, within the outermost of these, there is a single spine resembling the longest of the furrow series.

Color in alcohol dull gray, below white.

Type.—Cat. No. 36,895, U. S. N. M., from "Albatross" Station 2992, off Clarion Island, Lower California, in 460 fathoms.

Family GONIASTERIDÆ Forbes.

Subfamily Antheneinæ Fisher.

Anthenea mexicana new species.

Five arms; R=54 mm.; r=24 mm.; R:r=2.25:1; superomarginals 13 or 14.

Form stellate, with the interbrachial arcs and the tips of the rays well rounded. At the ends the arms are abruptly upturned so that the tips stand vertically.

The outline of the dorsal plates, which are flat and not tumid, is more or less concealed. These plates bear distinct, usually cylindrical, tubercles, which are arranged in regular rows parallel to the mid-radial line of the arms. The most prominent of these tubercles are in two rows, one on either side of the mid-radial line, about 3 mm. apart at the widest point, which run from a point half way between the center of the disk and the arm base almost to the arm tip; the slightly sunken naked area between these rows (occupying the mid-radial line of the arm) decreases very slightly in width toward the arm tip. Beyond these rows on either

side is another parallel row of somewhat smaller tubercles which runs from a point on the side of the interradial furrow half way between the center of the disk and the margin of the superomarginals to the level of the fourth or fifth superomarginal, where it disappears; these lateral rows are about as far from the median rows as the latter are apart. Beyond these long lateral rows on either side is a short lateral row arising on the border of the interradial furrow about two-thirds of the distance from the center of the disk to the superomarginals, and running to the level of the distal border of the second superomarginal.

Shallow, rather broad, furrows extend from the apical region of the disk to near the superomarginals; these are more or less petaloid in shape, and are 4 mm. in maximum diameter, half way between the center of the disk and the superomarginals; these furrows are bordered with a more or less irregular and indistinct row of tubercles, and carry within the groove three pairs of large low tubercles.

Many of the abactinal plates carry pedicellariæ which, however, seem to be absent from the arms.

The madreporic body is small, about 2.5 mm. in diameter, with rather coarse striæ.

The superomarginals decrease regularly in width to the arm bases, then remaining of practically the same width to near the ends of the arms; they are slightly tumid, and their surface is covered with well spaced, rather high, tubercular granules; except for a few of the terminal, each bears a pedicellaria.

The inferomarginals correspond to the superomarginals, which they resemble in all ways except in being slightly wider, and in not decreasing perceptibly in width until near the tip of the arms; all of them bear pedicellariæ.

The actinal intermediate plates are numerous, and are arranged in rows between the marginals and the adambulacrals; they bear very numerous well spaced globular tubercles; toward the periphery of the actinal surface these tubercles become smaller, and merge into the tubercles covering the inferomarginals. Nearly all of the actinal intermediate plates bear the characteristic pedicellariæ; these are largest on the plates bordering the adambulacrals, where they occur in a diagonal position, their long axis coinciding with that of the series of plates of which the plates bearing them are a part; further from the ambulacral grooves the pedicellariæ become smaller and more irregular in orientation, though most of them have their long axis parallel to that of the series including the plate which bears them.

The adambulacral plates are apparently about as long as broad; the furrow border is slightly curved; they carry five or six (usually five) furrow spines, graduated in height from the small and short outer to the long and stout strongly flattened central, which increase in diameter and end in a rounded tip. These plates, especially near the mouth, may carry a small pedicellaria on the proximal (adoral) border. Within the series of furrow spines there is a series of three stout spines, the central much the largest, parallel to the furrow; beyond this, and spaced from

it, there is a series of three much smaller and shorter spines, not greatly larger than the granular spines of the actinal intermediate plates, from which they are separated by a narrrow bare area.

The mouth plates have seven stout spines on the furrow border, which decrease very slightly in length; within the distal portion of the furrow border are two much stouter spines, and just within the apex another similar to these; along the inner margin of the plates is a row of five or six spines similar to these, but shorter.

Type.—Cat. No. 38,318, U. S. N. M., from the west coast of Mexico.

Family LINCKIIDÆ Perrier.

Narcissia gracilis new species.

Five arms; R=54 mm.; r=8.5 mm.; R:r=6.3:1; height to apex of abactinal region 7 mm.; width of arms at base 10 mm.

General form stellate, with long slender regularly tapering rays, upturned at the tip; the body is low, the maximum height being less than the diameter of the arms at their base; the arm section at the base is low, rounded triangular.

The center of the abactinal surface is occupied by a mass of plates of different sizes in which the primary plates can usually be distinguished. From this central mass of plates there runs down the mid-line of each of the arms a prominent series of elongate polygonal plates bordered on either side by a row of much smaller plates beyond which is another row of larger plates, which are nearly as large as the plates in the mid-radial series. At the middle of the arm the series of small plates on either side of the carinal series disappears, and the carinal series merges with the large plates of the series beyond, the three series combining to form a broad dorsal band of irregularly arranged subequal polygonal plates.

In the proximal half of the arm many, or most, of the plates in the carinal row and in the rows of larger plates on either side of it bear pedicellariæ, but these are absent in the outer half of the arm.

Between the rows of large plates on either side of the carinal series in the proximal half of the arm and the dorsal band of large plates in the distal half of the arm, and the superomarginals, there are five rows of plates decreasing very slowly in size from above (abactinally) downward; of these rows the lowest reaches only to the third-fifth superomarginal, the second reaches to the fifth-eighth, and the third reaches the eighth-twelfth; the fourth and fifth, distally becoming more or less irregular, persist nearly to the tip of the arm. The last thirteen-fifteen superomarginals are in contact with the mid-dorsal band of large plates.

The madreporite is small, circular, 1.5 mm. in diameter, situated midway between the center of the dorsal surface and the interbrachial angle.

The anus is rather prominent, excentric, protected by short stout spines.

Single papulæ occur in the angles between all the abactinal plates, excepting between the plates in the broad dorsal band in the distal half of the arm, where they are rare. There are no actinal papulæ.

Pedicellariæ are only exceptionally present on the smaller abactinal plates.

Superomarginals and inferomarginals large and prominent, of equal size, rounded oblong, slightly longer than broad, in the distal quarter of the arm becoming squarish and at the tip slightly broader than long. The two series correspond except at the upturned arm tip. As far as the distal third or fourth of the arm each superomarginal, and several of the inferomarginals, bears a delicate pedicellaria with two long and very slender jaws ending in a palmate tip which lies in a slit-like groove on the surface of the plate.

Intermarginal papulæ occur in the proximal half or two-thirds of the arms.

Between the inferomarginals and the adambulacrals there are several rows of actinal intermediate plates; the first of these, adjoining the adambulacrals, is composed of plates which at first are not much inferior to the latter in size, though in the outer half of the arm their size slowly diminishes; this row extends to the fifth or sixth inferomarginal from the end of the ray; most of the plates in the middle half of the row bear pedicellariæ like those of the marginals; above this is a second row of slightly smaller plates which extends to the seventh inferomarginal; a third row of still smaller plates reaches to the fourth inferomarginal, while above this last are two additional rows, one of which reaches the third, the other the second, inferomarginal; except in the first row none of these plates bear pedicellariæ.

The adambulacral plates are oblong, at first about twice as broad as long, decreasing slightly in length distally, and increasing again terminally; the plates in this series are separated from each other by prominent grooves. The furrow spines are four, becoming three in the distal half of the arm; they are triangular in cross section, the sharpest apex of the triangle being directed toward the center of the furrow border of the plate which bears them; the most proximal is the stoutest, and the two median are the most slender.

Beyond the furrow series there are three rows each composed of three short truncated spines which are triangular or polygonal in section; the innermost row, bordering the furrow spines, is somewhat curved, and is placed somewhat obliquely so that the distal end is nearer the furrow than the proximal; the spines of the outermost row are scarcely distinguishable from the granular investment of the body surface.

The mouth plates are triangular; each bears from seven to nine stout prismatic spines on the ambulacral border; on the common actinal surface of each pair there are from eight to ten stout prismatic spines which decrease in size outwardly.

The whole body is covered with closely packed fine hemispherical or polygonal granules which entirely conceal the outlines of the underlying plates; the only breaks in this granular covering are the papular pores and the narrow elongate grooves in which lie the pedicellariæ.

The color in alcohol is light yellowish, or dark brown.

Type.—Cat. No. 38,317, U. S. N. M., from "Albatross" Station 2829, off Lower California, in 31 fathoms.

Family ECHINASTERIDÆ Verrill.

Echinaster parvispinus new species.

Five arms; R=53 mm.; r=10 mm.; R:r=5.3:1.

The arms are robust, evenly tapering.

The abactinal plates are thick and heavy, but relatively small, arranged in three regular rows along the dorsal (abactinal) surface of the arms, with three additional irregular rows between the outermost of the dorsal rows and the superomarginals. The three dorsal rows of plates, which are about 2 mm. apart, form three rather prominent narrow and irregular ridges, and bear numerous short conical or cylindrical, sometimes capitate, jointed spines, usually two or three to a plate, which rarely reach 1 mm. in height, in an irregular zigzag series; in the carinal row there are about forty-five of these spines from the base to the tip of the arm.

The plates of the lateral rows are somewhat less regular in disposition, and are less elevated. The spines which they bear are more slender than the spines of the three median series, though not much smaller; this, combined with the lesser elevation of the plates, serves to make the lateral plates and spines noticeably less conspicuous than the median. The plates in these lateral rows are more numerous than those in the median, there being four in the former to three in the latter. In the lateral rows there is only one spine to a plate.

The center of the abactinal area bears scattered spines which are similar to those of the three median rows on the arms.

The madreporite is oval, about 2 mm. in the greater diameter, bearing short peripheral spines.

Papulæ are very abundant, in alcoholic specimens often appearing to form broad continuous lines which extend the whole length of the arms between the rows of spines. Single intermarginal papulæ may occur, especially toward the ends of the arms.

The superomarginals, which form a continuous band all along the arm, are irregular in shape, longer than broad; their spines, one to a plate, form a regular line all along the arm, and are similar in character to the spines on the plates above.

The inferomarginals proximally bear two (rarely three) spines similar to those of the superomarginals in a transverse series, these becoming reduced to one in the outer half of the arms.

In the actinal interradial areas only the spines of the inferomarginal series occur; these are commonly much reduced in size, and sometimes obsolete.

On the adambulacral plates the furrow series consists of three spines; the first of these is very small, recurved, situated on the inner face of the plate near the bottom of the groove; the next is nearly or quite twice as long, slender, situated half way up on the inner face, and the third is much stouter than the two preceding, situated on the inner border of the plate. Behind this third spine is another much smaller spine on the actinal surface of the plate.

Color in alcohol usually dark purplish or reddish brown, sometimes light pink.

Type.—Cat. No. 36,893, U. S. N. M., from "Albatross" Station 3021, Gulf of California, 14 fathoms.

Cyllaster new genus.

Genotype.—Cyllaster seminuda, new species.

The disk is very small.

The rays are slender (R=6r to 8.3r), usually subcylindrical, very flexible, usually arising somewhat abruptly from the disk; that is, there is usually a more or less straight, though short, interbrachial border.

The abactinal skeleton is more or less open, or aborted.

The papulæ are isolated, very large and conspicuous.

The marginal plates are more or less imperfectly developed and irregular, or absent altogether.

The adambulacral plates have from two to six sabre-shaped spines on the furrow face; the actinal surface is densely packed with from twenty to forty spines or spinules, all long, or one or two rows bordering the furrow long, the remainder short.

This genus is very closely related to *Henricia;* it includes, in addition to the type, *Cyllaster polyacantha* (Fisher), *C. clarki* (Fisher), and *C. pauperrima* (Fisher), all of which were originally described as *Henricia.*

Cyllaster seminuda new species.

Five arms; R=about 50 mm.; r=6 mm.; R:r=8.3:1.

The arms are very long, slender, approximately cylindrical, and very flexible; there are no marginals in either series.

The abactinal skeleton is very greatly reduced. A continuous line of very narrow elongate plates runs along the mid-dorsal line from the base of the arms to the tip; it does not extend onto the disk. Between this median line and the region normally occupied by marginals is a widely open, exceedingly irregular, meshwork of narrower and smaller plates; within the spaces between the narrow lines forming this meshwork are numerous granules. Exteriorly the plates and the granules bear numerous fine spines, those on the granules being usually one or two in number, though sometimes more, according to their size, those on the plates being irregularly distributed, on the mid-dorsal line showing a tendency to grouping. The skeleton becomes somewhat more dense at the arm tips. The disk and arm bases carry a few small detached plates and numerous spiniferous granules.

The interradial areas of the disk actinally have an irregular median column of very narrow plates which resembles the line of plates running down the midline of the arms, and numerous relatively large widely spaced granules, which become suddenly smaller and more numerous toward the abactinal surface.

Between the adambulacrals and the outer (actinal) border of the dorsal meshwork, covering the region normally occupied by the marginals, is a band occupied solely by very numerous minute spiniferous granules.

The madreporite is large, oval, with a few coarse irregular striæ situ-

ated on the border of the disk as viewed abactinally; it bears a few small spinelets about its border.

The papulæ are very large, abundant, and conspicuous, covering the dorsal surface of the disk and arms, and the lateral surfaces of the latter; on the sides of the arms they are arranged in regular diagonal lines; in the midradial region of the arms and on the disk their arrangement is irregular.

There are no traces of any plates between the adambulacrals and the actinal border of the dorsal meshwork.

The adambulacral plates at first are about twice as broad as long, becoming about as long as broad after the proximal third of the arm; each of these plates is separated from its neighbors by a distinct interval or suture.

The adambulacral plates bear within the furrow three long and very slender spines situated one above the other; on the furrow margin there are usually three longer and stouter spines, forming a furrow comb; these may be arranged with the central one in advance, or they may (more rarely) stand in a diagonal line with the outermost nearest the center of the furrow; the innermost spine on the furrow margin (whether the first or the second) is directly over the slender furrow spine. The typical arrangement seems to be, middle one in advance, proximal one slightly behind it, distal one considerably behind it. The middle one, which is larger than the others, is more or less sabre-shaped. The actinal surface of the plate is studded with small spinelets which are irregular in position.

The mouth plates are large and, owing to the absence of actinal intermediate, or other except adambulacral, plates, very conspicuous. The mouth spines are five in number, resembling the spines on the border of the adambulacrals. On the outermost angle, deep in the furrow, are two more spines, much smaller and more slender, of which the proximal is opposite the fifth of the furrow series, and the distal, which is slightly smaller, is situated slightly beyond. The inner half of the mouth plates is covered with small spinules, but the distal half is naked.

Color in alcohol brownish white.

Type.—Cat. No. 38,316, U. S. N. M., from "Albatross" Station 2993, off the Revillagigedo Islands, Lower California, in 364 fathoms.